FREIGHTLINER
Run Smart™

BUSINESS CLASS M2 MAINTENANCE MANUAL

Models: M2 100
M2 106
M2 106V
M2 112
M2 112V

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Foreword

Performing scheduled maintenance operations is important in obtaining safe, reliable operation of your vehicle. A proper maintenance program will also help to minimize downtime and safeguard warranties.

IMPORTANT: The maintenance operations in this manual are **not all-inclusive**. Also refer to other component and body manufacturers' instructions for specific inspection and maintenance instructions.

Perform the operations in this maintenance manual at scheduled intervals. Perform the pretrip and post-trip inspections, and daily/weekly/monthly maintenance, as outlined in the vehicle driver's manual. Major components, such as engines, transmissions, and rear axles, are covered in their own maintenance and operation manuals, that are provided with the vehicle. Perform any maintenance operations listed at the intervals scheduled in those manuals. Your Freightliner Dealership has the qualified technicians and equipment to perform this maintenance for you. They can also set up a scheduled maintenance program tailored specifically to your needs. Optionally, they can assist you in learning how to perform these maintenance procedures.

IMPORTANT: Descriptions and specifications in this manual were in effect at the time of printing. Freightliner Trucks reserves the right to discontinue models and to change specifications or design at any time without notice and without incurring obligation. Descriptions and specifications contained in this publication provide no warranty, expressed or implied, and are subject to revision and editions without notice.

Refer to **www.Daimler-TrucksNorthAmerica.com** and **www.FreightlinerTrucks.com** for more information, or contact Daimler Trucks North America LLC at the address below.

Environmental Concerns and Recommendations

Whenever you see instructions in this manual to discard materials, you should attempt to reclaim and recycle them. To preserve our environment, follow appropriate environmental rules and regulations when disposing of materials.

NOTICE: Parts Replacement Considerations

Do not replace suspension, axle, or steering parts (such as springs, wheels, hubs, and steering gears) with used parts. Used parts may have been subjected to collisions or improper use and have undetected structural damage.

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Descriptions of Service Publications

Daimler Trucks North America LLC distributes the following major service publications in paper and electronic (via ServicePro®) formats.

Workshop/Service Manual

Workshop/service manuals contain service and repair information for all vehicle systems and components, except for major components such as engines, transmissions, and rear axles. Each workshop/service manual section is divided into subjects that can include general information, principles of operation, removal, disassembly, assembly, installation, and specifications.

Maintenance Manual

Maintenance manuals contain routine maintenance procedures and intervals for vehicle components and systems. They have information such as lubrication procedures and tables, fluid replacement procedures, fluid capacities, specifications, and procedures for adjustments and for checking the tightness of fasteners. Maintenance manuals do not contain detailed repair or service information.

Driver's/Operator's Manual

Driver's/operator's manuals contain information needed to enhance the driver's understanding of how to operate and care for the vehicle and its components. Each manual contains a chapter that covers pretrip and post-trip inspections, and daily, weekly, and monthly maintenance of vehicle components. Driver's/operator's manuals do not contain detailed repair or service information.

Service Bulletins

Service bulletins provide the latest service tips, field repairs, product improvements, and related information. Some service bulletins are updates to information in the workshop/service manual. These bulletins take precedence over workshop/service manual information, until the latter is updated; at that time, the bulletin is usually canceled. The service bulletins manual is available only to dealers. When doing service work on a vehicle system or part, check for a valid service bulletin for the latest information on the subject.

IMPORTANT: Before using a particular service bulletin, check the current service bulletin validity list to be sure the bulletin is valid.

Parts Technical Bulletins

Parts technical bulletins provide information on parts. These bulletins contain lists of parts and BOMs needed to do replacement and upgrade procedures.

Web-based repair, service, and parts documentation can be accessed using the following applications on the AccessFreightliner.com website.

ServicePro

ServicePro® provides Web-based access to the most up-to-date versions of the publications listed above. In addition, the Service Solutions feature provides diagnostic assistance with Symptoms Search, by connecting to a large knowledge base gathered from technicians and service personnel. Search results for both documents and service solutions can be narrowed by initially entering vehicle identification data.

PartsPro

PartsPro® is an electronic parts catalog system, showing the specified vehicle's build record.

EZWiring

EZWiring™ makes Freightliner, Sterling, Western Star, Thomas Built Buses, and Freightliner Custom Chassis Corporation products' wiring drawings and floating pin lists available online for viewing and printing. EZWiring can also be accessed from within PartsPro.

Descriptions of Service Publications

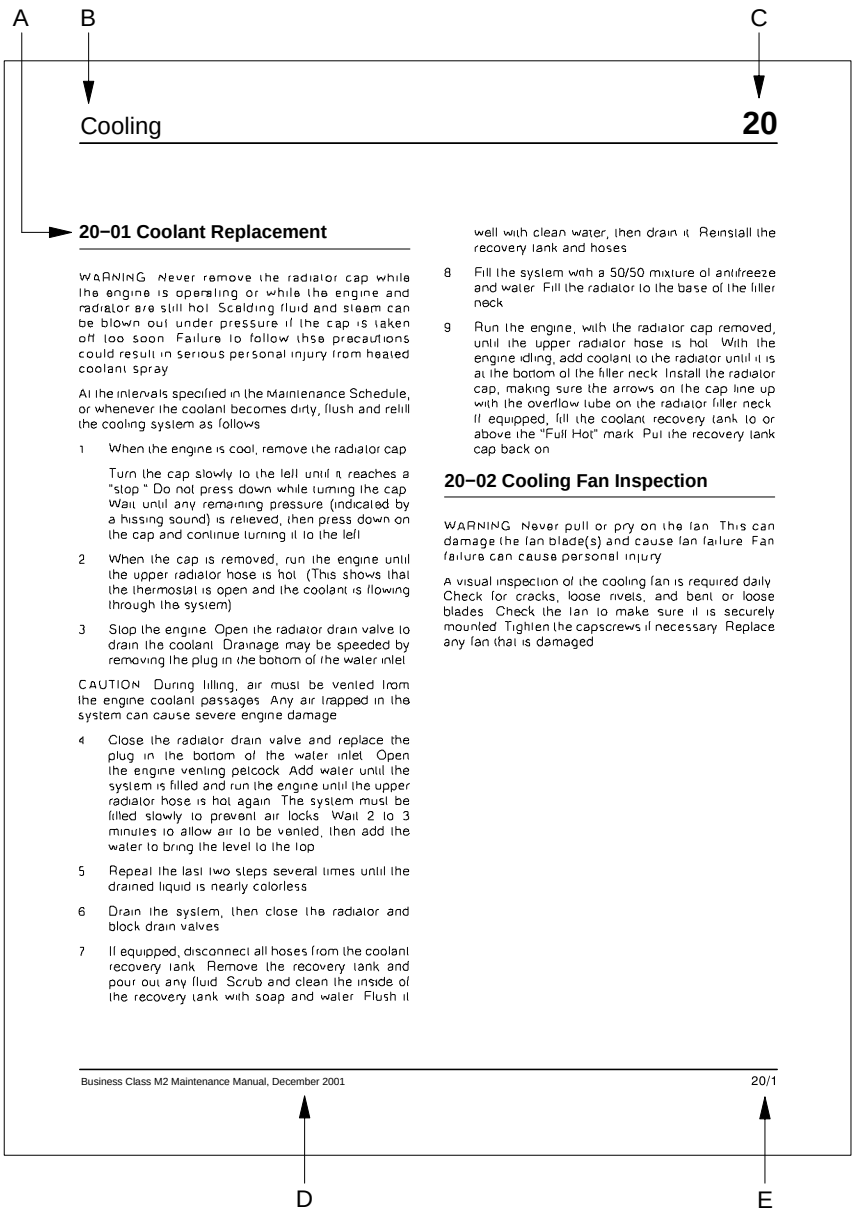
Warranty-related service information available on the AccessFreightliner.com website includes the following documentation.

Recall Campaigns Recall campaigns cover situations that involve service work or replacement of parts in connection with a recall notice. These campaigns pertain to matters of vehicle safety. All recall campaigns are distributed to dealers; customers receive notices that apply to their vehicles.

Field Service Campaigns Field service campaigns are concerned with non-safety-related service work or replacement of parts. All field service campaigns are distributed to dealers; customers receive notices that apply to their vehicles.

Page Description

For an example of a *Business Class M2 Maintenance Manual* page, see **Fig. 1**.


A
B
C
Cooling
20
20–01 Coolant Replacement
WARNING Never remove the radiator cap while the engine is operating or while the engine and radiator are still hot Scalding fluid and steam can be blown out under pressure if the cap is taken off too soon Failure to follow these precautions could result in serious personal injury from heated coolant spray
At the intervals specified in the Maintenance Schedule, or whenever the coolant becomes dirty, flush and refill the cooling system as follows
1 When the engine is cool, remove the radiator cap
Turn the cap slowly to the left until it reaches a "stop " Do not press down while turning the cap Wait until any remaining pressure (indicated by a hissing sound) is relieved, then press down on the cap and continue turning it to the left
2 When the cap is removed, run the engine until the upper radiator hose is hot (This shows that the thermostat is open and the coolant is flowing through the system)
3 Stop the engine Open the radiator drain valve to drain the coolant Drainage may be speeded by removing the plug in the bottom of the water inlet
CAUTION During filling, air must be vented from the engine coolant passages Any air trapped in the system can cause severe engine damage
4 Close the radiator drain valve and replace the plug in the bottom of the water inlet Open the engine venting petcock Add water until the system is filled and run the engine until the upper radiator hose is hot again The system must be filled slowly to prevent air locks Wait 2 to 3 minutes to allow air to be vented, then add the water to bring the level to the top
5 Repeat the last two steps several times until the drained liquid is nearly colorless
6 Drain the system, then close the radiator and block drain valves
7 If equipped, disconnect all hoses from the coolant recovery tank Remove the recovery tank and pour out any fluid Scrub and clean the inside of the recovery tank with soap and water Flush it well with clean water, then drain it Reinstall the recovery tank and hoses
8 Fill the system with a 50/50 mixture of antifreeze and water Fill the radiator to the base of the filler neck
9 Run the engine, with the radiator cap removed, until the upper radiator hose is hot With the engine idling, add coolant to the radiator until it is at the bottom of the filler neck Install the radiator cap, making sure the arrows on the cap line up with the overflow tube on the radiator filler neck If equipped, fill the coolant recovery tank to or above the "Full Hot" mark Put the recovery tank cap back on
20–02 Cooling Fan Inspection
WARNING Never pull or pry on the fan This can damage the fan blade(s) and cause fan failure Fan failure can cause personal injury
A visual inspection of the cooling fan is required daily Check for cracks, loose rivets, and bent or loose blades Check the fan to make sure it is securely mounted Tighten the capscrews if necessary Replace any fan that is damaged
Business Class M2 Maintenance Manual, December 2001
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E

12/06/2001 f020125

A. Maintenance Operation Number consists of the Group Number followed by the Sequence Number
B. Group Title
C. Group Number
D. Release Date
E. Group Number/Page Number

Fig. 1, Example of a Business Class M2 Maintenance Manual Page

Maintenance Manual Contents

Group No.	Group Title
00	General Information
01	Engine
09	Air Intake
13	Air Compressor
15	Alternators and Starters
20	Engine Cooling/Radiator
25	Clutch
26	Transmission
31	Frame and Frame Components
32	Suspension
33	Front Axle
35	Rear Axle
40	Wheels and Tires
41	Driveline
42	Brakes
46	Steering
47	Fuel
49	Exhaust
60	Cab
72	Doors
83	Heater and Air Conditioner
88	Hood, Grille, and Cab Fenders

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Determining Scheduled Maintenance Intervals	00–01
Initial Maintenance (IM) Operations	00–06
M1 Lubrication and Fluid Level Check	00–12
M1 Maintenance Operations	00–07
M2 Lubrication and Fluid Level Check	00–13
M2 Maintenance Operations	00–08
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Determining Scheduled Maintenance Intervals

Performing regular maintenance will help ensure that your vehicle delivers safe, reliable service and optimum performance. A proper maintenance program will also help to minimize downtime and safeguard warranties.

To determine the correct maintenance intervals for your vehicle, you must first determine the type of service or conditions the vehicle will be operating in. Most vehicles operate in conditions that fall within one of the three schedules. Before placing your vehicle in service, determine whether Schedule I, II, or III applies to your vehicle.

Schedules I-III

Schedule I (severe service) applies to vehicles that travel up to 6000 miles (10 000 kilometers) annually or that operate under severe conditions. Examples of Schedule I usage are:

- operation on extremely poor roads or where there is heavy dust accumulation
- constant exposure to extreme hot, cold, salt air, or other extreme climates
- frequent short-distance travel
- construction-site operation
- city operation such as fire truck and garbage truck.
- farm operation

Schedule II (short-haul transport) applies to vehicles that travel up to 60,000 miles (100 000 kilometers) annually and operate under normal conditions. Examples of Schedule II usage are:

- operation primarily in cities and densely populated areas
- local transport with infrequent freeway travel
- high percentage of stop-and-go travel

Schedule III (long-haul transport) is for vehicles that travel more than 60,000 miles (100 000 kilometers) annually with minimal city or stop-and-go operation. Examples of Schedule III usage are:

- regional delivery that is mostly freeway miles
- interstate transport
- any road operation with high annual mileage

Maintenance Schedules

After determining the schedule appropriate to your vehicle, refer to the Maintenance Schedules to determine when to perform the Initial Maintenance (IM) and the frequency of performing subsequent maintenance intervals for each schedule.

Maintenance Intervals

Refer to Maintenance Intervals for Schedule I, Schedule II, and Schedule III to determine which maintenance interval(s) should be performed when your vehicle reaches the mileage or hours of operation listed in these tables.

Maintenance Operations

Groups 01 through 83 in this manual have an index at the beginning of each Group. The index lists the Title of Maintenance Operations and the maintenance Operation (MOP) Numbers for that Group. Follow the instructions under the MOP number to perform the required maintenance.

In addition to the maintenance operations required for the maintenance interval, perform all the daily maintenance procedures in **Chapter 11**, "Pretrip Inspection and Daily Maintenance," in the *Business Class® M2 Driver's Manual*.

Maintenance Schedules: 00–02

Maintenance Schedules					
Schedule	**Maintenance Intervals**				
	Maintenance Interval	**Frequency**	**Mileage**	**km**	**Hours**
Schedule I* (severe service) for vehicles that travel up to 6000 miles (10 000 km) annually	Initial Maintenance (IM)	first	1000	1600	100
	Maintenance 1 (M1)	every	1000	1600	100
	Maintenance 2 (M2)	every	4000	6400	400
	Maintenance 3 (M3)	every	8000	12 800	800
	Maintenance 4 (M4)	every	16,000	25 600	1600
	Maintenance 5 (M5)	every	32,000	51 200	3200
Schedule II (short-haul transport) for vehicles that travel up to 60,000 miles (100 000 km) annually	Initial Maintenance (IM)	first	8000	12 000	—
	Maintenance 1 (M1)	every	8000	12 000	
	Maintenance 2 (M2)	every	16,000	24 000	
	Maintenance 3 (M3)	every	32,000	48 000	
	Maintenance 4 (M4)	every	64,000	96 000	
	Maintenance 5 (M5)	every	128,000	192 000	
Schedule III (long-haul transport) for vehicles that travel over 60,000 miles (100 000 km) annually	Initial Maintenance (IM)	first	10,000	16 000	—
	Maintenance 1 (M1)	every	10,000	16 000	
	Maintenance 2 (M2)	every	20,000	32 000	
	Maintenance 3 (M3)	every	40,000	64 000	
	Maintenance 4 (M4)	every	80,000	128 000	
	Maintenance 5 (M5)	every	160,000	256 000	

* For Schedule I vehicles equipped with an hourmeter, use maintenance intervals based on hours of operation rather than mileage.

Table 1, Maintenance Schedules

Maintenance Intervals for Schedule I: 00–03

Maintenance Intervals for Schedule I					
Maintenance Sequence	**Maintenance Interval**	**Service Date**	**Miles**	**km**	**Hours**
1st	IM and M1		1000	1600	100
2nd	M1		2000	3200	200
3rd	M1		3000	4800	300
4th	M1 and M2		4000	6400	400
5th	M1		5000	8000	500
6th	M1		6000	9600	600
7th	M1		7000	11 200	700
8th	M1, M2, and M3		8000	12 800	800
9th	M1		9000	14 400	900
10th	M1		10,000	16 000	1000
11th	M1		11,000	17 600	1100
12th	M1 and M2		12,000	19 200	1200
13th	M1		13,000	20 800	1300
14th	M1		14,000	22 400	1400
15th	M1		15,000	24 000	1500
16th	M1, M2, M3, and M4		16,000	25 600	1600
17th	M1		17,000	27 200	1700
18th	M1		18,000	28 800	1800
19th	M1		19,000	30 400	1900
20th	M1 and M2		20,000	32 000	2000
21st	M1		21,000	33 600	2100
22nd	M1		22,000	35 200	2200
23rd	M1		23,000	36 800	2300
24th	M1, M2, and M3		24,000	38 400	2400
25th	M1		25,000	40 000	2500
26th	M1		26,000	41 600	2600
27th	M1		27,000	43 200	2700
28th	M1 and M2		28,000	44 800	2800
29th	M1		29,000	46 400	2900
30th	M1		30,000	48 000	3000
31st	M1		31,000	49 600	3100
32nd	M1, M2, M3, M4, and M5		32,000	51 200	3200

Table 2, Maintenance Intervals for Schedule I

Maintenance Intervals for Schedules II and III: 00–04

Maintenance Intervals for Schedules II and III						
Maintenance Sequence	Maintenance Interval	Service Date	Schedule II		Schedule III	
			Miles	km	Miles	km
1st	IM and M1		8000	12 000	10,000	16 000
2nd	M1 and M2		16,000	24 000	20,000	32 000
3rd	M1		24,000	36 000	30,000	48 000
4th	M1, M2, and M3		32,000	48 000	40,000	64 000
5th	M1		40,000	60 000	50,000	80 000
6th	M1 and M2		48,000	72 000	60,000	96 000
7th	M1		56,000	84 000	70,000	112 000
8th	M1, M2, M3, and M4		64,000	96 000	80,000	128 000
9th	M1		72,000	108 000	90,000	144 000
10th	M1 and M2		80,000	120 000	100,000	160 000
11th	M1		88,000	132 000	110,000	176 000
12th	M1, M2, and M3		96,000	144 000	120,000	192 000
13th	M1		104,000	156 000	130,000	208 000
14th	M1, and M2		112,000	168 000	140,000	224 000
15th	M1		120,000	180 000	150,000	240 000
16th	M1, M2, M3, M4, and M5		128,000	192 000	160,000	256 000
17th	M1		136,000	204 000	170,000	272 000
18th	M1 and M2		144,000	216 000	180,000	288 000
19th	M1		152,000	228 000	190,000	304 000
20th	M1, M2, and M3		160,000	240 000	200,000	320 000
21st	M1		168,000	252 000	210,000	336 000
22nd	M1 and M2		176,000	264 000	220,000	352 000
23rd	M1		184,000	276 000	230,000	368 000
24th	M1, M2, M3, and M4		192,000	288 000	240,000	384 000
25th	M1		200,000	300 000	250,000	400 000
26th	M1 and M2		208,000	312 000	260,000	416 000
27th	M1		216,000	324 000	270,000	432 000
28th	M1, M2, and M3		224,000	336,000	280,000	448 000
29th	M1		232,000	348 000	290,000	464 000
30th	M1 and M2		240,000	360 000	300,000	480 000
31st	M1		248,000	372 000	310,000	496 000
32nd	M1, M2, M3, M4, and M5		256,000	384 000	320,000	512 000

Table 3, Maintenance Intervals for Schedules II and III

Overview of Maintenance Operations: 00–05

Maintenance Operations for Groups 00 through 88							
Maintenance Operation No.	Title of Maintenance Operation	Maintenance Intervals					
		IM	M1	M2	M3	M4	M5
01-01	Engine Drive Belt Inspecting				•	•	•
01-02	Engine Support Fastener Checking					•	•
09-01	Air Cleaner Element Inspecting and Replacing					•	•
13-01	Air Compressor Inspecting			•	•	•	•
15-01	Alternator, Battery, and Starter Checking					•	•
20-01	Radiator Cap Inspecting			•	•	•	•
20-02	Radiator Pressure Flushing and Coolant Changing					•	•
20-03	Fan Drive Inspecting (Noise Emission Control)			•	•	•	•
20-04	Hybrid Electric System Coolant Changing					•	•
25-01	Eaton Fuller Clutch Release Bearing Lubricating	•	•	•	•	•	•
25-02	Eaton Fuller Clutch Release Cross-Shaft Lubricating	•	•	•	•	•	•
25-03	Clutch Hydraulic Fluid Level Checking	•	•	•	•	•	
25-04	Clutch Hydraulic Fluid Changing						•
25-05	Clutch Adjusting, Manually Adjusted Clutches	•	•	•	•	•	•
26-01	Manual Transmission Fluid Level Checking	•	•	•	•		
26-02	Eaton Fuller Transmission Fluid Changing and Magnetic Plug Cleaning*			•	•	•	•
26-03	Allison and Eaton Fuller Transmission Breather Checking	•	•	•	•	•	•
26-04	Eaton Fuller Transmission Air Filter/Regulator Element Cleaning			•	•	•	•
26-05	Allison Transmission Fluid and Filter Changing				•	•	•
26-06	Mercedes-Benz Transmission Fluid Changing and Magnetic Plug Cleaning						•
26-07	Mercedes-Benz Transmission Leak Checking						•
31-01	Frame Fastener Torque Checking	•				•	•
31-02	Fifth Wheel Inspecting	•	•	•	•	•	•
31-03	Fifth Wheel Lubricating	•	•	•	•	•	•
31-04	Trailer Electrical Connector Lubricating	•	•	•	•	•	•
32-01	Suspension Inspecting	•	•	•	•	•	•
32-02	Suspension Lubricating	•	•	•	•	•	•
32-03	Suspension U-Bolt Torque Checking	•			•	•	•
33-01	Kingpin Lubricating	•	•	•	•	•	•
33-02	Tie Rod End Lubricating	•	•	•	•	•	•
33-03	Draw Key Nut Torque Checking	•			•	•	•
33-04	Tie Rod End Inspecting	•	•	•	•	•	•

Overview of Maintenance Operations: 00–05

Maintenance Operations for Groups 00 through 88							
Maintenance Operation No.	Title of Maintenance Operation	Maintenance Intervals					
		IM	M1	M2	M3	M4	M5
33-05	Wheel End Inspection and Maintenance, 6,000-Pound and 8,000-Pound Steer Axles with Oil-Lubricated Hubs†	•	•	•	•	•	•
35-01	Axle Lubricant Level Checking	•	•	•	•		
35-02	Axle Breather Checking	•	•	•	•	•	•
35-03	Axle Lubricant Changing and Magnetic Plug Cleaning					•	•
40-01	Wheel Nut Checking				•	•	•
41-01	Driveline Inspecting	•	•	•	•	•	•
41-02	Driveline Lubricating	•	•	•	•	•	•
42-01	Air Brake System Valve Inspecting	•	•	•	•	•	•
42-02	Bendix AD–9 Air Dryer Desiccant Replacing‡		•	•	•	•	•
42-03	Governor D–2A Checking					•	•
42-04	Bosch Hydraulic Brake System Inspecting	•	•	•	•	•	•
42-05	Bendix AD–IP Air Dryer Desiccant Replacing‡		•	•	•	•	•
42-06	Haldex and Gunite Slack Adjuster Lubricating	•	•	•	•	•	•
42-07	Meritor Camshaft Bracket Lubricating			•	•	•	•
42-08	Meritor Slack Adjuster Lubricating	•	•	•	•	•	•
42-09	Bendix AD–IS Air Dryer Desiccant Replacing‡		•	•	•	•	•
42-10	Air Dryer AD–9, AD–IP, and AD–IS/DRM Checking			•	•	•	•
42-11	Brake Lines and Fittings Inspecting, Hydraulic Brakes	•	•	•	•	•	•
42-12	Brake Pedal Linkage and Mounting Plate Inspecting			•	•	•	•
42-13	Air Brake Inspecting and Leak Testing				•	•	•
42-14	Foot-Control Valve, E6, Inspecting and Lubricating						•
42-15	Brake Inspecting	•	•	•	•	•	•
42-16	Bendix Hydro-Max® Brake System Inspecting	•	•	•	•	•	•
46-01	Drag Link Inspecting				•	•	•
46-02	Power Steering Fluid Changing					•	•
46-03	Power Steering Fluid Level Inspecting	•	•	•	•		
46-04	Power Steering Gear Lubricating	•	•	•	•	•	•
46-05	Drag Link Lubricating	•	•	•	•	•	•
46-06	Power Steering Filter Changing						•
47-01	Fuel Tank Band Nut Tightening	•					
47-02	Fuel/Water Separator Element Replacing					•	•
47-03	LNG Fuel System Inspecting		•	•	•	•	•
47-04	LNG Vacuum Integrity Testing				•	•	•
47-05	CNG Fuel System Inspecting			•	•	•	•

Overview of Maintenance Operations: 00–05

Maintenance Operations for Groups 00 through 88							
Maintenance Operation No.	Title of Maintenance Operation	Maintenance Intervals					
		IM	M1	M2	M3	M4	M5
47-06	CNG High-Pressure Fuel Filter Element Replacing		•	•	•	•	•
47-07	CNG Fuel Cylinder Inspecting				•	•	•
49-01	Exhaust System Inspecting (Noise Emission Control)			•	•	•	•
49-02	CAT CGI Bellows and Piping Inspection		•	•	•	•	•
49-03	CAT CGI Bellows Replacement						•
60-01	Mirror Folding Check					•	•
72-01	Door Seals Lubricating	•	•	•	•	•	•
83-01	Air Conditioner Inspecting	•	•	•	•	•	•
83-02	HVAC Air Filter Replacing§				•	•	•
88-01	Hood Rear Support Lubrication		•	•	•	•	•

* Change petroleum-based lubricants at M2 (including M3, M4, and M5). Change synthetic lubricants at M5 only.

† Schedule II and Schedule III vehicles only.

‡ If equipped with an oil-coalescing desiccant cartridge, replace the cartridge once a year, regardless of mileage. Otherwise use the M5 maintenance interval.

§ Replace the HVAC air filter at the recommended interval or every six months.

Table 4, Maintenance Operations for Groups 00 through 88

Initial Maintenance (IM) Operations: 00–06

NOTE: The IM Operations include the maintenance operations in **Table 5** and all of the maintenance operations in **Table 6**, M1 Maintenance Operations.

Initial Maintenance (IM) Operations	
Maintenance Operation No.	**Title of Maintenance Operation**
00-07	Perform All M1 Operations
31-01	Frame Fastener Torque Checking
32-03	Suspension U-Bolt Torque Checking
33-03	Draw Key Nut Torque Checking
47-01	Fuel Tank Band Nut Tightening

Table 5, Initial Maintenance (IM) Operations

M1 Maintenance Operations: 00–07

IMPORTANT: After performing all operations listed in this table, perform all daily, weekly, and monthly maintenance operations listed in the "Pretrip and Post-Trip Inspections and Maintenance" chapter of the *Business Class® M2 Driver's Manual*.

M1 Maintenance Operations	
Maintenance Operation No.	**Title of Maintenance Operation**
00-12	Lubrication and Fluid Level Check • Eaton Fuller Clutch Release Bearing Lubricating • Eaton Fuller Clutch Release Cross-Shaft Lubricating • Clutch Hydraulic Fluid Level Checking • Manual Transmission Fluid Level Checking • Fifth Wheel Lubricating • Trailer Electrical Connector Lubricating • Suspension Lubricating • Kingpin Lubricating • Tie Rod End Lubricating • Axle Lubricant Level Checking • Driveline Lubricating • Haldex and Gunite Slack Adjuster Lubricating • Meritor Slack Adjuster Lubricating • Power Steering Fluid Level Inspecting • Power Steering Gear Lubricating • Drag Link Lubricating • Door Seals Lubricating • Hood Rear Support Lubrication
25-05	Clutch Adjusting, Manually Adjusted Clutches
26-03	Allison and Eaton Fuller Transmission Breather Checking
31-02	Fifth Wheel Inspecting
32-01	Suspension Inspecting
33-04	Tie Rod End Inspecting
33-05	Wheel End Inspection and Maintenance, 6,000-Pound and 8,000-Pound Steer Axles with Oil-Lubricated Hubs*
35-02	Axle Breather Checking
41-01	Driveline Inspecting
42-01	Air Brake System Valve Inspecting
42-02	Bendix AD-9 Air Dryer Desiccant Replacing (with an oil-coalescing desiccant cartridge)†
42-04	Bosch Hydraulic Brake System Inspecting

M1 Maintenance Operations: 00–07

M1 Maintenance Operations	
Maintenance Operation No.	**Title of Maintenance Operation**
42-05	Bendix AD-IP Air Dryer Desiccant Replacing (with an oil-coalescing desiccant cartridge)†
42-09	Bendix AD-IS Air Dryer Desiccant Replacing (with an oil-coalescing desiccant cartridge)†
42-11	Brake Lines and Fittings Inspecting, Hydraulic Brakes
42-15	Brake Inspecting
47-03	LNG Fuel System Inspecting
47-06	CNG High-Pressure Fuel Filter Element ‡
49-02	CAT CGI Bellows and Piping Inspection
83-01	Air Conditioner Inspecting

* Schedule III vehicles only.

† If equipped with an oil-coalescing desiccant cartridge, replace the cartridge once a year, regardless of mileage. Otherwise use the M5 maintenance interval.

‡ M1 maintenance interval should be used as a general guideline; the actual frequency of filter element replacement will vary depending on cleanliness of the fuel station system.

Table 6, M1 Maintenance Operations

NOTE: The M2 Maintenance Operations include the maintenance operations in **Table 7** and all of the maintenance operations in **Table 9**, M1 Maintenance Operations.

M2 Maintenance Operations	
Maintenance Operation No.	**Title of Maintenance Operation**
00-07	Perform All M1 Maintenance Operations
00-13	Lubrication and Fluid Level Check • Eaton Fuller Transmission Fluid Changing and Magnetic Plug Cleaning* • Meritor Camshaft Bracket Lubricating
13-01	Air Compressor Inspecting
20-01	Radiator Cap Inspecting
20-03	Fan Drive Inspecting (Noise Emission Control)
26-04	Eaton Fuller Transmission Air Filter/Regulator Element Cleaning
33-05	Wheel End Inspection and Maintenance, 6,000-Pound and 8,000-Pound Steer Axles with Oil-Lubricated Hubs†
42-10	Air Dryer AD–9, AD–IP, and AD–IS/DRM Checking
42-12	Brake Pedal Linkage and Mounting Plate Inspecting
47-05	CNG Fuel System Inspecting
49-01	Exhaust System Inspecting (Noise Emission Control)

* Petroleum-based lubricants only.

† Schedule II vehicles only.

Table 7, M2 Maintenance Operations

M3 Maintenance Operations: 00–09

NOTE: The M3 Maintenance Operations include the maintenance operations in **Table 8** and all of the maintenance operations in **Table 6**, M1 Maintenance Operations, and **Table 7**, M2 Maintenance Operations.

M3 Maintenance Operations	
Maintenance Operation No.	**Title of Maintenance Operation**
00-07	Perform All M1 Maintenance Operations
00-08	Perform All M2 Maintenance Operations
01-01	Engine Drive Belt Inspecting
26-05	Allison Transmission Fluid and Filter Changing
32-03	Suspension U-Bolt Torque Checking
33-03	Draw Key Nut Torque Checking
40-01	Wheel Nut Checking
42-13	Air Brake Inspecting and Leak Testing
46-01	Drag Link Inspecting
47-04	LNG Vacuum Integrity Testing
47-07	CNG Fuel Cylinder Inspecting
83-02	HVAC Air Filter Replacing*

* Replace the HVAC air filter at the recommended interval or every six months.

Table 8, M3 Maintenance Operations

M4 Maintenance Operations: 00–10

NOTE: The M4 Maintenance Operations include the maintenance operations in **Table 9** and all of the maintenance operations in **Table 6**, M1 Maintenance Operations, **Table 7**, M2 Maintenance Operations, and **Table 8**, M3 Maintenance Operations.

M4 Maintenance Operations	
Maintenance Operation No.	**Title of Maintenance Operation**
00-07	Perform All M1 Maintenance Operations
00-08	Perform All M2 Maintenance Operations
00-09	Perform All M3 Maintenance Operations
01-02	Engine Support Fastener Checking
09-01	Air Cleaner Element Inspecting and Replacing
15-01	Alternator, Battery, and Starter Checking
20-02	Radiator Pressure Flushing and Coolant Changing
20-04	Hybrid Electric System Coolant Changing
31-01	Frame Fastener Torque Checking
35-03	Axle Lubricant Changing and Magnetic Plug Cleaning
42-03	Governor D–2A Checking
46-02	Power Steering Fluid Changing
47-02	Fuel/Water Separator Element Replacing
60-01	Mirror Folding Check

Table 9, M4 Maintenance Operations

M5 Maintenance Operations: 00–11

NOTE: The M5 Maintenance Operations include the maintenance operations in **Table 10** and all of the maintenance operations in **Table 6**, M1 Maintenance Operations, **Table 7**, M2 Maintenance Operations, **Table 8**, M3 Maintenance Operations, and **Table 9**, M4 Maintenance Operations.

M5 Maintenance Operations	
Maintenance Operation No.	**Title of Maintenance Operation**
00-07	Perform All M1 Maintenance Operations
00-08	Perform All M2 Maintenance Operations
00-09	Perform All M3 Maintenance Operations
00-10	Perform All M4 Maintenance Operations
25-04	Clutch Hydraulic Fluid Changing
26-06	Mercedes-Benz Transmission Fluid Changing and Magnetic Plug Cleaning
26-07	Mercedes-Benz Transmission Leak Checking
42-02	Bendix AD-9 Air Dryer Desiccant Replacing
42-05	Bendix AD-IP Air Dryer Desiccant Replacing
42-09	Bendix AD-IS Air Dryer Desiccant Replacing
42-14	Foot-Control Valve, E6, Inspecting and Lubricating
46-06	Power Steering Filter Changing
49-03	CAT CGI Bellows Replacement

Table 10, M5 Maintenance Operations

Table 11, MOP 00-12, lists the lubrication and fluid level check maintenance operations that must be performed at the M1 Maintenance Interval.

MOP 00-12, M1 Lubrication and Fluid Level Check	
Maintenance Operation No.	**Title of Maintenance Operation**
25-01	Eaton Fuller Clutch Release Bearing Lubricating
25-02	Eaton Fuller Clutch Release Cross-Shaft Lubricating
25-03	Clutch Hydraulic Fluid Level Checking
26-01	Manual Transmission Fluid Level Checking
31-03	Fifth Wheel Lubricating
31-04	Trailer Electrical Connector Lubricating
32-02	Suspension Lubricating
33-01	Kingpin Lubricating
33-03	Tie Rod End Lubricating
35-01	Axle Lubricant Level Checking
41-02	Driveline Lubricating
42-06	Haldex and Gunite Slack Adjuster Lubricating
42-08	Meritor Slack Adjuster Lubricating
46-03	Power Steering Fluid Level Inspecting
46-04	Power Steering Gear Lubricating
46-05	Drag Link Lubricating
72-01	Door Seals Lubricating
88-01	Hood Rear Support Lubrication

Table 11, MOP 00-12, M1 Lubrication and Fluid Level Check

M2 Lubrication and Fluid Level Check: 00–13

Table 12, MOP 00-13, lists the lubrication and fluid level check maintenance operations that must be performed at the M2 Maintenance Interval.

MOP 00-13, M2 Lubrication and Fluid Level Check	
Maintenance Operation No.	**Title of Maintenance Operation**
26-02	Eaton Fuller Transmission Fluid Changing and Magnetic Plug Cleaning*
42-07	Meritor Camshaft Bracket Lubrication

* Petroleum-based lubricants only.

Table 12, MOP 00-13, M2 Lubrication and Fluid Level Check

Noise Emission Controls

Federal Law, Part 205: Transportation Equipment Noise Emission Controls

Part 205, Transportation Equipment Noise Emission Controls, requires the vehicle manufacturer to furnish each new vehicle with written instructions for the proper maintenance, use, and repair of the vehicle by the ultimate purchaser to provide reasonable assurance of the elimination or minimization of noise emission degradation throughout the life of the vehicle. In compliance with the law, the Noise Emission Control Systems maintenance located in each applicable group within this manual, in conjunction with the vehicle workshop manual, provides these instructions to owners.

Recommendations for Replacement Parts

Replacement parts used for maintenance or repair of noise emission control systems should be genuine Freightliner parts. If other than genuine Freightliner parts are used for replacement or repair of components affecting noise emission control, the owner should be sure that such parts are warranted by their manufacturer to be equivalent to genuine Freightliner parts in performance and durability.

Freightliner Noise Emissions Warranty

Refer to the vehicle owner's warranty information book for warranty information concerning noise emission control systems.

Tampering With the Noise Control System is Prohibited

Federal law prohibits the following acts or the causing thereof:

1. The removal or rendering inoperative by any person other than for purposes of maintenance, repair, or replacement, of any device or element of design incorporated into any new vehicle for the purpose of noise control prior to its sale or delivery to the ultimate purchaser or while it is in use,
2. The use of the vehicle after such device or element of design has been removed or rendered inoperative by any person.

Among those acts presumed to constitute tampering are the acts listed below:

1. Removal of engine noise-deadening panels, including cab or hood liners.
2. Removal of or rendering inoperative the engine speed governor so as to allow engine speed to exceed the manufacturer's specifications.
3. Removal of or rendering inoperative the fan clutch, including bypassing the control on any thermostatic fan drive to cause it to operate continuously.
4. Removal of the fan shroud.
5. Removal of or rendering inoperative exhaust system components, including exhaust pipe clamping.
6. Removal of air intake system components.

Verification of Inspections Log: 00–16

Verification of Inspections Log

The "Verification of Inspections Log" should be filled out each time the vehicle's noise emission controls are maintained or repaired.

Verification of Inspections Log, Group 20

Verification of Inspections Log, Group 20, Engine Cooling/Radiator				
Date	**Mileage**	**Repair Description**	**Cost**	**Repair Facility**

Verification of Inspections Log, Group 49

Verification of Inspections Log, Group 49, Exhaust				
Date	**Mileage**	**Repair Description**	**Cost**	**Repair Facility**

Metric/U.S. Customary and Temperature Conversions: 00–17

Metric/U.S. Customary Conversions					
When You Know U.S. Customary	**Multiply By**	**To Get Metric**	**When You Know Metric**	**Multiply By**	**To Get U.S. Customary**
Length					
inches (in)	25.4	millimeters (mm)		0.03937	inches (in)
inches (in)	2.54	centimeters (cm)		0.3937	inches (in)
feet (ft)	0.3048	meters (m)		3.281	feet (ft)
yards (yd)	0.9144	meters (m)		1.094	yards (yd)
miles (mi)	1.609	kilometers (km)		0.6215	miles (mi)
Area					
square inches (in^2)	645.16	square millimeters (mm^2)		0.00155	square inches (in^2)
square inches (in^2)	6.452	square centimeters (cm^2)		0.155	square inches (in^2)
square feet (ft^2)	0.0929	square meters (m^2)		10.764	square feet (ft^2)
Volume					
cubic inches (in^3)	16387.0	cubic millimeter (mm^3)		0.000061	cubic inches (in^3)
cubic inches (in^3)	16.387	cubic centimeters (cm^3)		0.06102	cubic inches (in^3)
cubic inches (in^3)	0.01639	liters (L)		61.024	cubic inches (in^3)
fluid ounces (fl oz)	29.54	milliliters (mL)		0.03381	fluid ounces (fl oz)
pints (pt)	0.47318	liters (L)		2.1134	pints (pt)
quarts (qt)	0.94635	liters (L)		1.0567	quarts (qt)
gallons (gal)	3.7854	liters (L)		0.2642	gallons (gal)
cubic feet (ft^3)	28.317	liters (L)		0.03531	cubic feet (ft^3)
cubic feet (ft^3)	0.02832	cubic meters (m^3)		35.315	cubic feet (ft^3)
Weight/Force					
ounces (av) (oz)	28.35	grams (g)		0.03527	ounces (av) (oz)
pounds (av) (lb)	0.454	kilograms (kg)		2.205	pounds (av) (lb)
U.S. tons (t)	907.18	kilograms (kg)		0.001102	U.S. tons (t)
U.S. tons (t)	0.90718	metric tons (t)		1.1023	U.S. tons (t)
Torque/Work Force					
inch-pounds (lbf·in)	11.298	Newton centimeters (N·cm)		0.08851	inch pounds (lbf·in)
foot-pounds (lbf·ft)	1.3558	Newton meters (N·m)		0.7376	foot pounds (lbf·ft)
Pressure/Vacuum					
inches of mercury (inHg)	3.37685	kilo Pascals (kPa)		0.29613	inches of mercury (inHg)
pounds per square inch (psi)	6.895	kilo Pascals (kPa)		0.14503	pounds per square inch (psi)

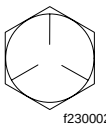
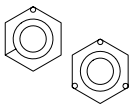
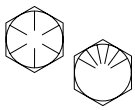
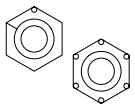
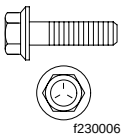
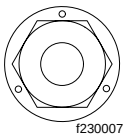
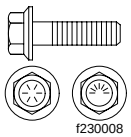
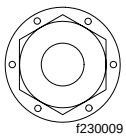
Table 13, Metric/U.S. Customary Conversions

Metric/U.S. Customary and Temperature Conversions: 00–17

Temperature Conversions							
When You Know	Subtract	Then Divide By	To Get	When You Know	Multiply By	Then Add	To Get
degrees Fahrenheit (°F)	32	1.8	degrees Celsius (°C)	1.8		32	degrees Fahrenheit (°F)

Table 14, Temperature Conversions

Torque Specifications: 00–18

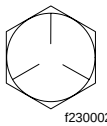
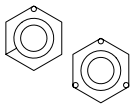
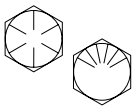
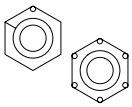
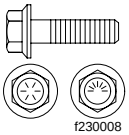
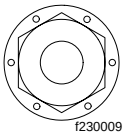
Torque Values for U.S. Customary Thread Fasteners With Lubricated* or Plated Threads†								
Thread Diameter–Pitch	Regular Hex				Flanged			
	Grade 5 Bolt	Grade 5 or B Nut	Grade 8 or 8.2 Bolt	Grade 8 or C Nut	Grade 5 Bolt	Grade B Nut	Grade 8 or 8.2 Bolt	Grade G Nut
	Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)	
	 f230002	 f230003	 f230004	 f230005	 f230006	 f230007	 f230008	 f230009
1/4–20	7 (9)		8 (11)		6 (8)		10 (14)	
1/4–28	8 (11)		9 (12)		7 (9)		12 (16)	
5/16–18	15 (20)		16 (22)		13 (18)		21 (28)	
5/16–24	16 (22)		17 (23)		14 (19)		23 (31)	
3/8–16	26 (35)		28 (38)		23 (31)		37 (50)	
3/8–24	30 (41)		32 (43)		25 (34)		42 (57)	
7/16–14	42 (57)		45 (61)		35 (47)		60 (81)	
7/16–20	47 (64)		50 (68)		40 (54)		66 (89)	
1/2–13	64 (87)		68 (92)		55 (75)		91 (123)	
1/2–20	72 (98)		77 (104)		65 (88)		102 (138)	
9/16–12	92 (125)		98 (133)		80 (108)		130 (176)	
9/16–18	103 (140)		110 (149)		90 (122)		146 (198)	
5/8–11	128 (173)		136 (184)		110 (149)		180 (244)	
5/8–18	145 (197)		154 (209)		130 (176)		204 (277)	
3/4–10	226 (306)		241 (327)		200 (271)		320 (434)	
3/4–16	253 (343)		269 (365)		220 (298)		357 (484)	
7/8–9	365 (495)		388 (526)		320 (434)		515 (698)	
7/8–14	402 (545)		427 (579)		350 (475)		568 (770)	
1–8	—		582 (789)		—		—	
1–12	—		637 (863)		—		—	
1–14	—		652 (884)		—		—	

* Freightliner recommends that all plated and unplated fasteners be coated with oil before installation.

† Use these torque values if either the bolt or nut is lubricated or plated (zinc-phosphate conversion-coated, cadmium-plated, or waxed).

Table 15, Torque Values for U.S. Customary Thread Fasteners With Lubricated or Plated Threads

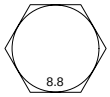
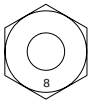
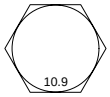
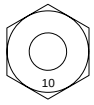
Torque Specifications: 00–18

Torque Values for U.S. Customary Thread Fasteners With Dry (Unlubricated)* Plain (Unplated) Threads†						
Thread Diameter–Pitch	Regular Hex				Flanged	
	Grade 5 Bolt	Grade 5 or B Nut	Grade 8 or 8.2 Bolt	Grade 8 or C Nut	Grade 8 or 8.2 Bolt	Grade G Nut
	Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)	
	 f230002	 f230003	 f230004	 f230005	 f230008	 f230009
1/4–20	8 (11)		10 (14)		—	
1/4–28	9 (12)		12 (16)		—	
5/16–18	15 (20)		22 (30)		22 (30)	
5/16–24	17 (23)		25 (34)		—	
3/8–16	28 (38)		40 (54)		40 (54)	
3/8–24	31 (42)		45 (61)		—	
7/16–14	45 (61)		65 (88)		65 (88)	
7/16–20	50 (68)		70 (95)		—	
1/2–13	70 (95)		95 (129)		95 (129)	
1/2–20	75 (102)		110 (149)		—	
9/16–12	100 (136)		140 (190)		140 (190)	
9/16–18	110 (149)		155 (210)		—	
5/8–11	135 (183)		190 (258)		190 (258)	
5/8–18	155 (210)		215 (292)		—	
3/4–10	240 (325)		340 (461)		340 (461)	
3/4–16	270 (366)		380 (515)		—	
7/8–9	385 (522)		540 (732)		—	
7/8–14	425 (576)		600 (813)		—	
1–8	580 (786)		820 (1112)		—	
1–12	635 (861)		900 (1220)		—	
1–14	650 (881)		915 (1241)		—	

* Threads may have residual oil, but will be dry to the touch.

† Male and female threads (bolt and nut) must both be unlubricated and unplated. If either is plated or lubricated, use **Table 15**. Freightliner recommends that all plated and unplated fasteners be coated with oil before installation.

Table 16, Torque Values for U.S. Customary Thread Fasteners With Dry (Unlubricated) Plain (Unplated) Threads

Torque Values for Metric Thread Fasteners With Lubricated* or Plated Threads†				
Thread Diameter–Pitch	Class 8.8 Bolt	Class 8 Nut	Class 10.9 Bolt	Class 10 Nut
	Torque: lbf·ft (N·m)		Torque: lbf·ft (N·m)	
	 f230010	 f230011	 f230012	 f230013
M6	5 (7)		7 (9)	
M8	12 (16)		17 (23)	
M8 x 1	13 (18)		18 (24)	
M10	24 (33)		34 (46)	
M10 x 1.25	27 (37)		38 (52)	
M12	42 (57)		60 (81)	
M12 x 1.5	43 (58)		62 (84)	
M14	66 (89)		95 (129)	
M14 x 1.5	72 (98)		103 (140)	
M16	103 (140)		148 (201)	
M16 x 1.5	110 (149)		157 (213)	
M18	147 (199)		203 (275)	
M18 x 1.5	165 (224)		229 (310)	
M20	208 (282)		288 (390)	
M20 x 1.5	213 (313)		320 (434)	
M22	283 (384)		392 (531)	
M22 x 1.5	315 (427)		431 (584)	
M24	360 (488)		498 (675)	
M24 x 2	392 (531)		542 (735)	
M27	527 (715)		729 (988)	
M27 x 2	569 (771)		788 (1068)	
M30	715 (969)		990 (1342)	
M30 x 2	792 (1074)		1096 (1486)	

* Freightliner recommends that all plated and unplated fasteners be coated with oil before installation.

† Use these torque values if either the bolt or nut is lubricated or plated (zinc-phosphate conversion-coated, cadmium-plated, or waxed).

Table 17, Torque Values for Metric Thread Fasteners With Lubricated or Plated Threads

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Engine Drive Belt Inspecting	01–01
Engine Support Fastener Checking	01–02

01–01 Engine Drive Belt Inspecting

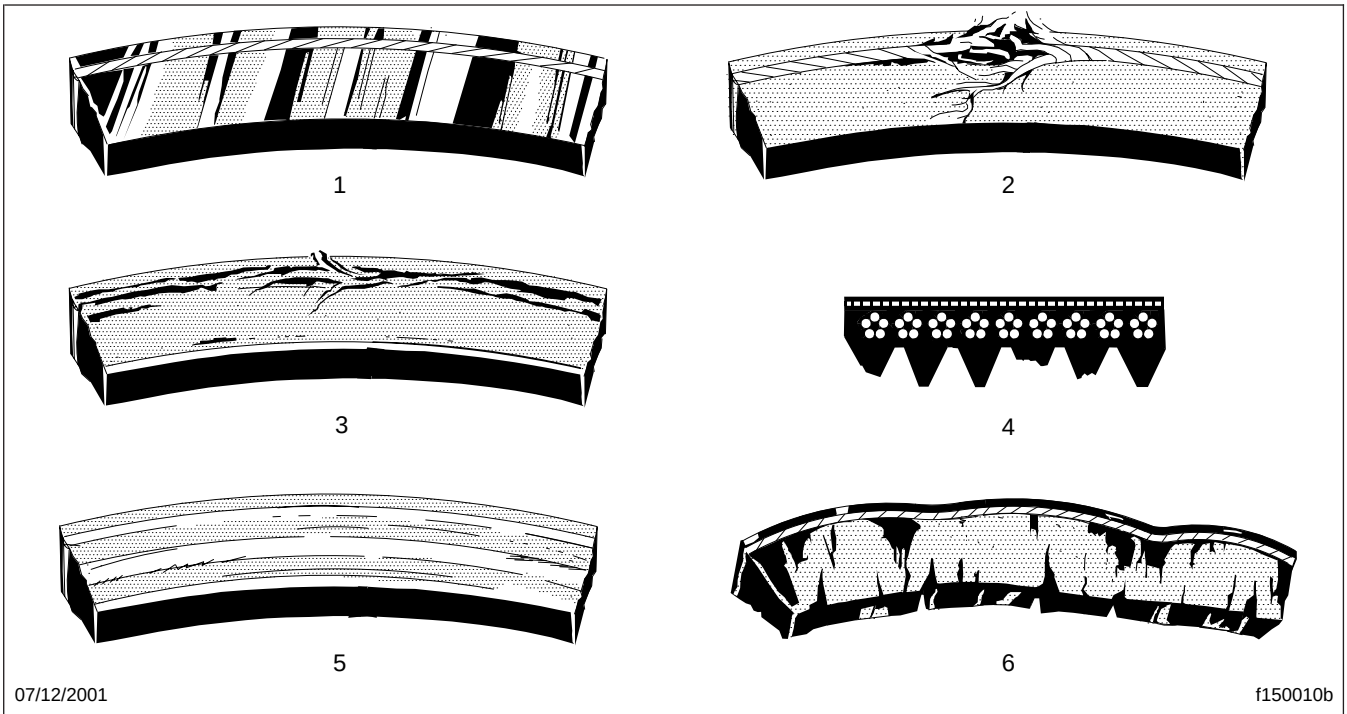
Worn or loose drive belts may cause premature pulley bearing failure or engine overheating. Too much or too little tension on the belt may result in excessive or premature belt wear. Replace the engine drive belt if any conditions described under *Visual Inspection* are found.

Visually inspect all drive belts, then perform the belt tension inspection. To inspect a belt, gently twist the belt to view the belt sidewalls and the underside of the belt. When replacing a matched set of belts, always replace both belts at the same time. Matched belts must be from the same manufacturer.

Visual Inspection

For examples of drive belt conditions, see **Fig. 1**.

1. Inspect the belt for glazing. Shiny sidewalls are evidence of glazing, which is caused by friction created when a loose belt slips in the pulleys. It can also be caused by oil or grease contamination on the pulleys.
2. Check for tensile breaks or breaks in the cord body. Cuts in a belt are usually caused by foreign material in the pulley or by prying or forcing the belt during removal or installation.
3. Check the belt for ply separation. Oil, grease, or belt dressing can cause the belt to fall apart in layers. Repair any oil or coolant leaks that are affecting the belts before replacing the drive belts. Do not use belt dressing on any belt.
4. Check for uneven ribs on serpentine (poly-V) belts. Foreign material in the pulley will erode the undercord ribs causing the belt to lose its gripping power.
5. Check the belt for a jagged or streaked sidewall. Jagged or streaked sidewalls are the result of



1. Glazing
2. Tensile Break
3. Separating Layers
4. Uneven Ribs
5. Streaked Sidewalls
6. Cracks

Fig. 1, Drive Belt Replacement Conditions

foreign material, such as sand or gravel, in the pulley, or a rough pulley surface.

6. Check the drive belts for cracks. Small, irregular cracks are usually indication of an old belt.
7. Visually inspect the pulleys for excessive play or wobble. Excessive play or wobble indicates a failure of the pulley bearing. Check for belt squealing or squeaking. Replace the bearings as necessary.

NOTE: If it is difficult to distinguish the location of a supposed bearing noise, obtain a stethoscope and place it on the component being checked, not the pulley, to isolate the area from outside interference.

8. Inspect all pulleys for foreign material, oil, or grease in the grooves.

   If the engine drive belt needs to be replaced, see **Group 01** of the *Business Class® M2 Workshop Manual*.

Belt Tension Inspection

Engine drive belts on the Mercedes-Benz and Caterpillar engines have belt tensioners that automatically adjust the tension on the belt. These belts do not require adjustment.

Caterpillar 3126 Engine

Inspect the belt tensioner for unusual noise and excessive looseness or shaking of the pulley bearings. See **Fig. 2**. If the belt tensioner requires disassembly, refer to the engine service manual.

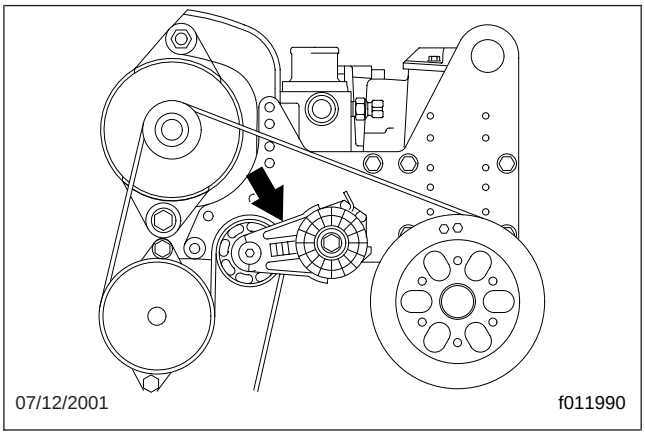


Fig. 2, Belt Tensioner on Caterpillar 3126 Engine

01–02 Engine Support Fastener Checking

Front and rear engine supports for vehicles built from January 2007 require no periodic maintenance. Mounts should be inspected when the engine is removed for service. For vehicles manufactured prior to January 2007, perform the following check.

1. Check the tightness of the engine support fasteners at the rear of the engine. Tighten the fasteners 241 lbf·ft (460 N·m).
2. Check the tightness of the engine support fasteners at the front of the engine. Tighten the fasteners 136 lbf·ft (327 N·m).

NOTE: When the engine is removed, inspect the lower and upper isolators for wear. Replace the isolators if necessary.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Air Cleaner Element Inspection and Replacement	09–01

09–01 Air Cleaner Element Inspection and Replacement

Restriction of air flow through the air cleaner element is measured at the tap in the air cleaner outlet. Check the restriction indicator at the air cleaner or in the cab if the vehicle is equipped with a dash-mounted restriction gauge.

Vehicles may be equipped with either a manual-reset restriction indicator with graduations (**Fig. 1**), or a go/no-go restriction indicator without graduations (**Fig. 2**).

1. Inspect the air restriction indicator to see if air restriction equals or exceeds the maximum allowable restriction. For instructions, see the *Business Class® M2 Driver's Manual*.
2. If necessary, replace the air cleaner element. For air cleaner element replacement instructions, see **Group 09** of the *Business Class® M2 Workshop Manual*.
3. Inspect the air cleaner housing for cracks, leaks, or any other damage. If the air cleaner housing or element is damaged, replace it.
4. Reset the air restriction indicator.
5. Each time the air cleaner housing is replaced, perform the procedures in **MOP 13–01**.

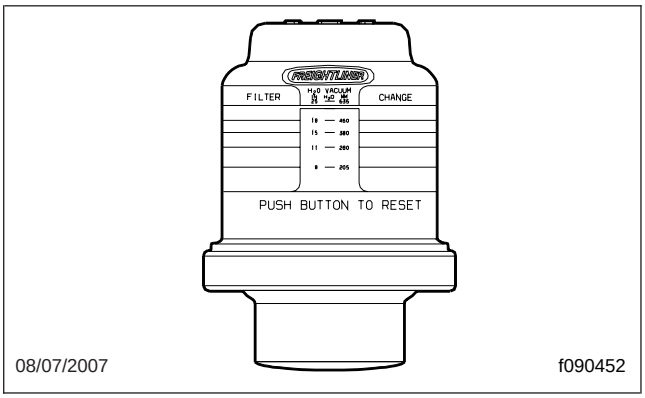


Fig. 1, Manual-Reset Air Restriction Indicator, Graduated

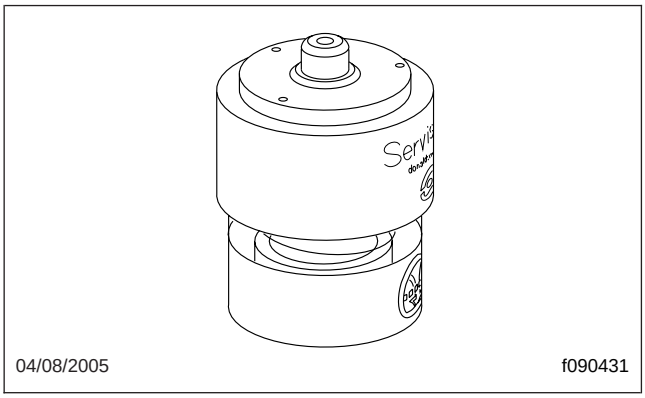


Fig. 2, Manual-Reset Air Restriction Indicator, Go/No-Go

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Air Compressor Inspecting	13–01

13–01 Air Compressor Inspecting

1. Inspect the air compressor intake adaptors at both ends of the line for physical damage. Replace the adaptors if necessary.
2. Inspect the air intake line, oil supply and return lines, and coolant supply and return lines for tight connections. Tighten the connections and replace the lines if needed.
3. Check the cooling fins on the air compressor crankcase. Clean the fins if they are clogged with debris.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Alternator, Battery, and Starter Checking	15–01

15–01 Alternator, Battery, and Starter Checking

⚠ WARNING

Batteries release explosive gas as a by-product of their chemical activity. Do not smoke when working around batteries. Put out all flames and remove any source of sparks or intense heat. Make sure the battery compartment is completely vented before disconnecting or connecting the battery cables.

Battery acid is extremely harmful if splashed in the eyes or on the skin. Always wear a face shield and protective clothing when working around batteries.

Damaged, chafed, or kinked wiring can cause electrical short-circuits and lead to fires, causing property damage, injury, or death. Clean, inspect, and maintain wiring and connections carefully.

1. Check the tightness of the alternator bracket fasteners; tighten the fasteners as needed. For torque values, see **Group 15** of the *Business Class® M2 Workshop Manual*.
2. See **Group 01** for belt tension specifications. Check the alternator drive belt tension, using a tension gauge at the belt's longest span. Some engines are equipped with more than one alternator belt; check all of them for correct tension. Adjust the belt tension if necessary.

   Engines equipped with a serpentine or poly-V belt have automatic belt tensioners, and do not require belt tension inspection.
3. Check that all electrical connections at the alternator and starter are clean. Clean and tighten all charging system electrical connections including the connections at the starter B terminal and ground terminal, and where the alternator charging cable terminates.

   Trace and inspect all wiring and cables connected to:

   - Alternator
   - Starter and depopulation studs
   - Batteries
   - Magnetic switch
   - Cab
   - Jump-start studs
   - Battery isolation relays
   - Battery shutoff switches
4. Check wires and cables for wear, chafing, kinks, discolored insulation, or loose clamps or ties. Find the cause of any problems and repair, replace, and reroute wires and clamps as necessary.
5. Check the alternator wiring for missing insulation, kinks, and heat damage. Replace or repair as needed.
6. On the bundled cable that runs from the batteries to the starter, ensure that tie straps are installed at least every 12 inches (300 mm). Replace any missing tie straps, and add tie straps where spacing between them exceeds 12 inches (300 mm).
7. Ensure that all cables have sufficient slack to allow for engine movement, and that there is no pressure on any wiring connectors.
8. If any convoluted tubing is damaged, check the wiring inside it. Replace any damaged or missing convoluted tubing.
9. Clean the cable connector terminals with a wire brush. See **Group 54** of the *Business Class® M2 Workshop Manual* for troubleshooting instructions, and for adjustment, repair, or replacement instructions.

   9.1 Clean and tighten the battery ground cable, terminal, and clamps.

   9.2 Inspect the retainer assembly (or battery hold-downs) and the battery box. Replace worn or damaged parts. Remove any corrosion with a wire brush, and wash with a weak solution of baking soda and water. Rinse with clean water and dry. To prevent rusting, paint the retainer assembly.

   9.3 Check for and remove any foreign objects such as stones, bolts, or nuts, from the battery box.

   9.4 After cleaning, connect the cables to the batteries, and tighten them to the torque specifications listed on the battery, generally 10 to 15 lbf·ft (14 to 20 N·m).

9.5 Coat the battery terminals with dielectric grease.

10. Check the terminals on the battery shut-off switch and the magnetic switch. Make sure the terminal connections are clean and tight. Coat the terminal connections with dielectric red enamel after cleaning.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Fan Drive Inspecting (Noise Emission Control)	20–03
Hybrid Electric System Coolant Changing	20–04
Radiator Cap Inspecting	20–01
Radiator Pressure Flushing and Coolant Changing	20–02

20–01 Radiator Cap Inspecting

⚠ WARNING

Do not remove or loosen the radiator cap until the engine and cooling system have completely cooled. Use extreme care when removing the cap. A sudden release of pressure from removing the cap prior to the system cooling can result in a surge of scalding coolant that could cause serious personal injury.

⚠ CAUTION

The radiator cap currently installed may not be the same one installed when the vehicle was built. If the radiator cap must be replaced, make sure that it is the correct cap for the cooling system of the vehicle. Because the radiator cap pressure rating affects the operating temperature of the engine, installing an improperly rated radiator cap may have adverse effects on the cooling system, and engine operating temperatures. This could cause premature engine wear or damage.

1. Using a radiator-cap tester, check the pressure cap to see if it maintains pressure to within 10 percent of the pressure rating marked on the cap. If it doesn't, replace the cap. Make sure that the replacement radiator cap is correctly rated for the cooling system of the vehicle.
2. There is a second valve in the radiator cap that opens under vacuum. This prevents the collapse of hoses and other parts that are not internally supported when the system cools. Inspect the vacuum-relief valve to be sure it is not stuck.
3. Make sure that the cap seals properly on the coolant filler neck seat, and that the radiator cap gasket is not damaged. On vehicles with screw-on caps with O-rings, make sure that the O-ring is not cracked or deteriorated. Replace the cap if the gasket shows deterioration or damage.

20–02 Radiator Pressure Flushing and Coolant Changing

NOTE: For additional instructions on cleaning and flushing the cooling system, see the engine maintenance and operation manual.

⚠ WARNING

Drain the coolant only when the coolant and engine are cool. Draining it when these are hot could cause severe personal injury due to scalding.

1. Drain the radiator, as follows.
   - 1.1 Place a large container under the radiator.
   - 1.2 Remove the surge tank cap.
   - 1.3 Open the petcock at the bottom of the radiator to drain the engine coolant.
2. Disconnect the radiator inlet and outlet hose connections.
3. Flush the radiator, as follows.
   - 3.1 Attach a flushing gun nozzle to the radiator outlet.
   - 3.2 Add water to the radiator until it is full.

⚠ CAUTION

When flushing the radiator, do not apply more than 20 psi (138 kPa) air pressure. Excessive pressure can damage the radiator or heater core.

   - 3.3 Apply no more than 20 psi (138 kPa) air pressure intermittently to help dislodge sediment buildup in the core.
4. Drain the radiator, then flush the radiator until clean water flows from it. Remove the flushing gun.
5. Close the petcock.
6. Using clamps, connect the hoses to the radiator. Torque the clamps 33 to 38 lbf·in (370 to 430 N·cm).

IMPORTANT: On vehicles with EPA07 compliant engines, the coolant capacity varies depending on the engine and accessory installation. After

servicing the cooling system, always verify that the coolant level is between the MIN and MAX lines on the surge tank.

7. Fill the radiator with coolant. Use a mixture of 50 percent water and 50 percent corrosion-inhibiting antifreeze to protect the engine to –34°F (–37°C) year round.

   See **Table 1** for engine cooling system capacities.

   See **Table 2** for approved antifreezes.

Coolant Capacities (pre-EPA07 engines)	
Engine Make and Model	**Coolant Volume: quarts (liters)**
Caterpillar 3126	35 (33.1)
MBE904	32 (30.3)
MBE906	37 (35)

Table 1, Coolant Capacities (pre-EPA07 engines)

Approved Coolants	
Coolant Manufacturer	**Coolant Designation***
Texaco	JC04 Antifreeze
Van Waters and Rogers Ltd. (Canada)	Diesel Antifreeze No. 6038

* Freightliner-approved antifreeze must meet one of the following conditions: A. Ethylene glycol solution that meets GM 6038–M Engineering Standards. B. Ethylene glycol solution that has less than 0.1% anhydrous sodium metasilicate and meets either GM 1825–M or GM 1899–M Engineering Standards.

Table 2, Approved Coolants

20–03 Fan Drive Inspecting (Noise Emission Control)

Horton Advantage® Fan Clutch

1. Check the fan for loose rivets and missing weights. Check for bent, cracked, or missing blades. Tighten loose components. Replace the fan drive if necessary.
2. Check for adequate clearance between the fan and the fan shroud or other engine compartment components in both the engaged mode and the disengaged mode. If the clearance is not adequate, make the necessary adjustments.
3. Check the fan belt condition and the belt alignment. Replace or correct as necessary.

Horton HT650 Fan Drive

Check for friction facing wear condition. Replace when worn to 1/16-inch (1.5-mm) thick, when oil spotted, or when burn marks are visible.

Kysor K22RA, K22FA, and K26RA Fan Drives

1. Check the fan for missing, cracked, chipped, or damaged blades. Tighten loose components. Replace damaged fans if necessary.
2. Check for adequate clearance around the fan. The fan should be centered in the shroud to prevent contact between the fan and the shroud.
3. Check the fan belt for proper alignment and condition. If the belt is worn or frayed, replace the belt.
4. Verify the fan drive engagement. With the engine and ignition key switch off, apply at least 90 psi (620 kPa) to the clutch; the fan should rotate freely. Remove air pressure from the clutch and the fan should not rotate.
5. With the fan drive disengaged, check for air leaks at the front of the clutch and between the clutch and the drive hub. If an air leak is detected, the clutch seals and hub must be inspected for wear or damage. If necessary, the seals of the clutch can be replaced with a Kysor rebuild kit. If inspection of the hub indicates excessive wear, rebuild the hub using a hub rebuild kit from Kysor.
6. Any time the clutch is removed for repair or replacement, the pulley hub and bearings should be inspected for play, roughness, or damage. Hub bearing service kits are available from Kysor.
7. Check the lining with the System Alert Tool™. If the lining is worn, install the appropriate lining kit. A lining that is prematurely worn is caused by control air supply problems. Inspect and correct the vehicle control system before placing the vehicle back in service.

8. Check the air line entry and routing at the front or rear of the fan drive. Look for cracked, damaged, or improperly routed air lines. Make sure the connections are tight and that there are no air leaks.
9. Check the electrical connections at the solenoid valve. The solenoid valve is part of the air module unit (AMU), which is located on the rear crossmember. Check the exhaust port for restrictions. If a restriction is found, clear it.

Horton DriveMaster® Fan Clutch

NOTE: If any part of the fan clutch needs to be repaired or replaced after performing the checks below, see **Group 20** of the *Business Class® M2 Workshop Manual*.

1. Disconnect the batteries at the negative terminals. Drain all air from the air system. If equipped with an air starter, drain the air starter reservoir.

⚠ WARNING

Make sure the batteries are disconnected before checking the fan clutch. If the engine starts during this procedure, the fan could engage, which could result in serious personal injury.

2. Inspect the electrical connections and wires to the fan clutch solenoid. Secure the connection if loose; replace wires and connectors if damaged.
3. Clean the fan clutch air solenoid valve filter, if equipped.
   - 3.1 Unscrew the fan clutch solenoid valve air filter assembly, and remove the filter element.
   - 3.2 Clean the filter element with cleaning solvent.
   - 3.3 Using a clean, lint-free cloth, wipe off any excess solvent.
   - 3.4 Reassemble the clutch valve solenoid air filter assembly, and install it on the vehicle.
4. Visually check the fan for bent, cracked, or damaged blades. Replace if damaged. Check for adequate clearance between the fan and other components.
5. Check the fan belt for wear, tension, and alignment. Correct, if necessary.
6. Check for wear on the friction facing. Replace the friction facing if it is worn to a 3/16-inch (4.8-mm) thickness or less. Also check the facing for signs of oil contamination or burn marks. If evidence of oil or burn marks are found, replace the friction facing.
7. Connect the battery cables. Start the engine, and charge the air system to 120 psi (827 kPa). Manually engage and disengage the fan clutch.

   Check the fan and the fan clutch from a distance. Look for vibration, fan blade contact, fan clutch slippage, and overall fan clutch operation.

   If the fan clutch does not operate correctly, see **Group 20** of the *Business Class® M2 Workshop Manual* for troubleshooting and repair procedures.
8. With the air system charged to 120 psi (827 kPa), check the fan clutch for audible air leaks, using a suitable listening device.

   Check at the solenoid valve, the air filter assembly, and the air hoses and fittings. See **Fig. 1**. Using a wet finger or a soapy water solution, check for a leak in the same areas.

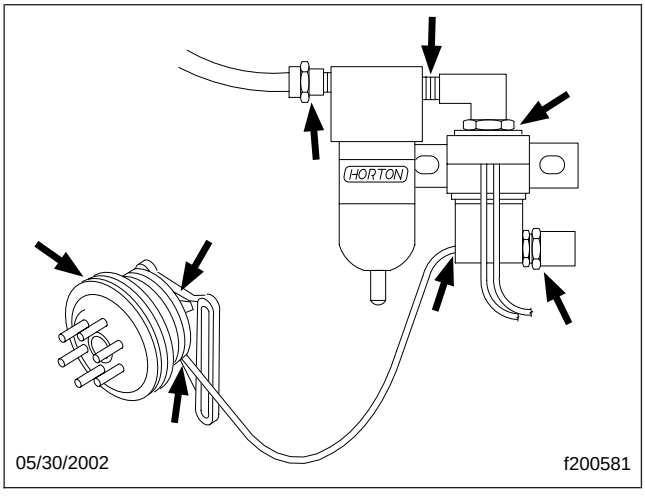


Fig. 1, Checking for Air Leaks (Horton DriveMaster)

9. If a leak is detected, remove the fan blade. Install a new seal kit. See **Group 20** of the *Business Class® M2 Workshop Manual* for repair procedures.

10. Check the fan drive for discoloration or any other signs of slipping or overheating.

NOTE: The fan clutch may slip if the air supply pressure is below 70 psi (483 kPa) or if there is a leak inside the fan clutch. Any leak must be remedied.

11. Check the fan clutch bearings.
    - 11.1 Turn the fan in both directions and feel for worn hub bearings.
    - 11.2 If possible, remove the drive belt and check for worn sheave bearings by turning the sheave in both directions.
    - 11.3 If either the hub or sheave bearings are worn, replace them, using a Horton DriveMaster Super Kit.

      For instructions and kit part number, see **Group 20** of the *Business Class® M2 Workshop Manual*.

20–04 Hybrid Electric System Coolant Changing

1. Disconnect the 12-volt vehicle batteries to isolate the high voltage power source.
2. Drain the hybrid radiator, as follows.
    - 2.1 Place a large container under the hybrid radiator.
    - 2.2 Remove the cap from the coolant reservoir.
    - 2.3 If equipped with a petcock, open it at the bottom of the hybrid radiator to drain the coolant.
    - 2.4 Disconnect the lower radiator hose, and drain the remaining coolant.
    - 2.5 Close the petcock, if equipped.
3. Install the lower radiator hose.
4. Fill the system with a coolant mixture of 50 percent ethylene glycol and 50 percent water.
5. Using ServiceRanger[1], activate the HEV coolant pump to purge any air that may be trapped in the system. Run the cooling pump until the air bubbles stop appearing in the reservoir tank.
6. Check the coolant level, and add coolant as needed. The system should be filled to the mid level of the reservoir.

[1] ServiceRanger is a service and diagnostic software program available from Eaton Corporation. See the Eaton website, **www.roadranger.com** for more information.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Clutch Adjusting, Manually Adjusted Clutches	25–05
Clutch Hydraulic Fluid Changing	25–04
Clutch Hydraulic Fluid Level Checking	25–03
Eaton Fuller Clutch Release Bearing Lubricating	25–01
Eaton Fuller Clutch Release Cross-Shaft Lubricating	25–02

25–01 Eaton Fuller Clutch Release Bearing Lubricating

The standard clutch release bearing is sealed, and does not require lubrication. If the vehicle is not equipped with a maintenance-free sealed clutch release bearing, lubricate the bearing as follows:

1. Park the vehicle on a level surface. Apply the parking brakes, and chock the rear tires.
2. Remove the clutch inspection plate.

NOTE: Some clutch release bearings are equipped with a lubrication extension that extends outside of the clutch housing. It is not necessary to remove the clutch inspection plate when the lubrication extension is used.

NOTE: For lubricating the release bearing, Eaton Fuller recommends a lithium-base high-temperature grease that meets the NLGI grade one or two specification.

3. Wipe the dirt away from the grease fitting. See **Fig. 1**. Use a low-pressure-type grease gun equipped with the recommended grease, and lubricate the bearing until excess grease purges from the rear of the release bearing (toward the transmission).

⚠ CAUTION

Do not over-lubricate the clutch release bearing. Over-lubrication could contaminate the clutch internally, causing clutch slippage and premature failure. Do not use chassis grease or multipurpose lubricants.

4. Wipe off excess grease and apply it to both the yoke finger and sleeve bushing contact points. See **Fig. 2**.
5. Install the clutch inspection plate.
6. Remove the chocks.

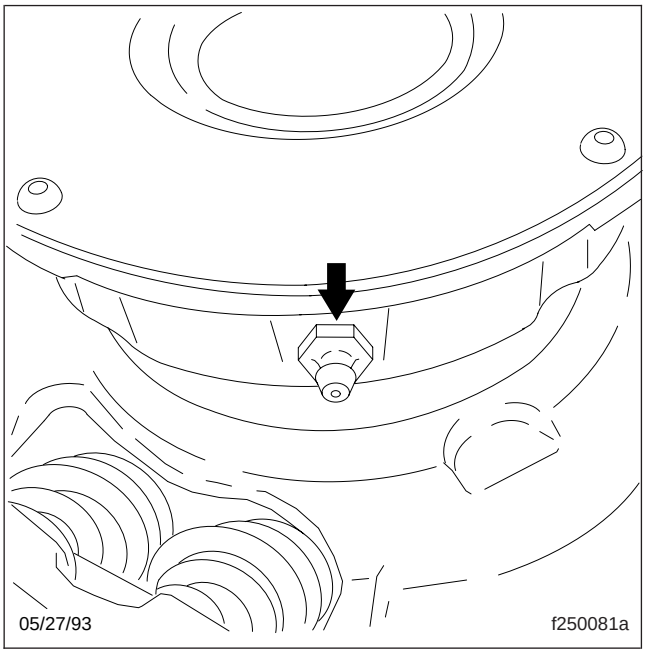
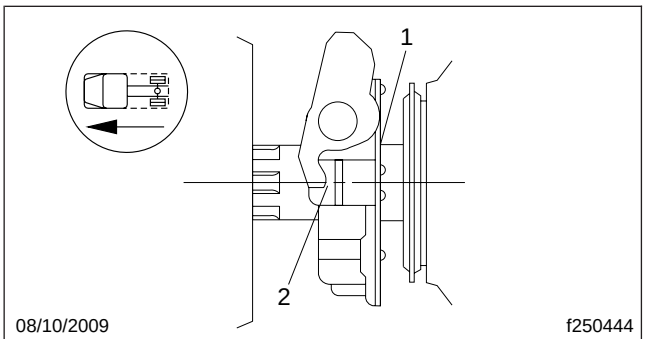


Fig. 1, Release Bearing Grease Fitting



1. Sleeve Bushing Contact Point
2. Yoke Finger Contact Points

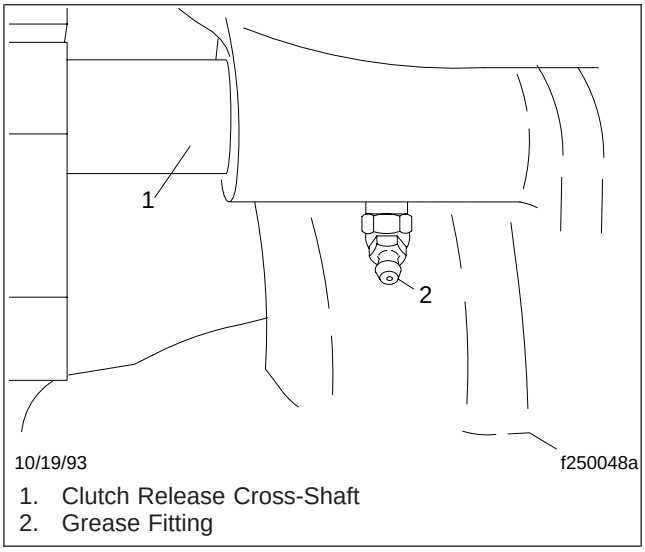
Fig. 2, Grease the Contact Points

25–02 Eaton Fuller Clutch Release Cross-Shaft Lubricating

IMPORTANT: This maintenance operation pertains only to vehicles equipped with mechanical (not hydraulic) linkages.

The clutch release cross-shaft is equipped with two grease fittings in the transmission clutch housing. See **Fig. 3** and **Fig. 4**. Wipe the dirt from the grease

fittings and lubricate with multipurpose chassis grease.



1. Clutch Release Cross-Shaft
2. Grease Fitting

Fig. 3, Cross-Shaft Grease Fitting, Left Side

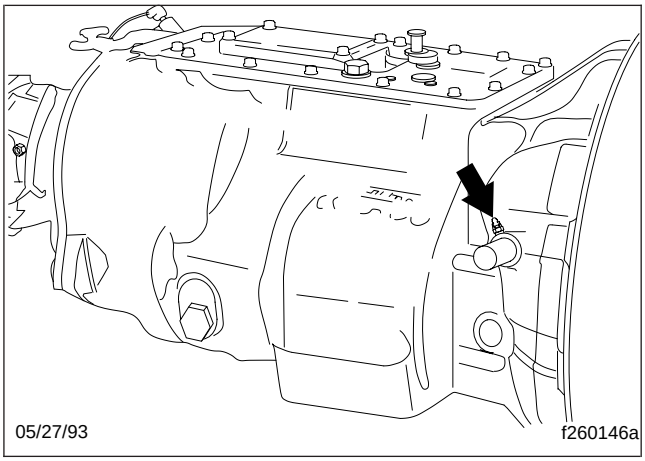


Fig. 4, Cross-Shaft Grease Fitting, Right Side

25–03 Clutch Hydraulic Fluid Level Checking

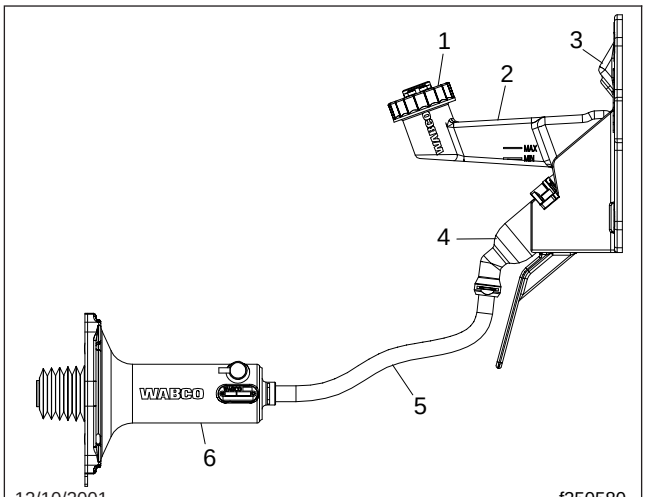
⚠ WARNING

Use only approved clutch hydraulic fluid (DOT 4 brake fluid) in the clutch hydraulic system. Do not mix different types of brake fluid. The wrong fluid will damage the rubber parts of the system, causing loss of clutch function and the risk of serious personal injury.

⚠ CAUTION

Do not allow the fluid level in the reservoir to go below the MIN line. If too much air enters, the hydraulic system will not operate correctly, and the clutch could be damaged.

If the fluid level is below the MIN line, fill the reservoir with DOT 4 brake fluid until the level reaches the MAX line. See **Fig. 5**.



1. Reservoir Cap
2. Reservoir
3. Pedal Unit
4. Master Cylinder
5. Hydraulic Hose
6. Slave Cylinder

Fig. 5, Clutch Components

25–04 Clutch Hydraulic Fluid Changing

Replace the clutch hydraulic fluid every two years to ensure clutch function is reliable and correct. Use the procedures below. Fluid replacement must be done at an authorized Freightliner service facility.

Flushing

1. Shut down the engine.
2. Apply the parking brakes, chock the front and rear tires, and raise the hood.

⚠ WARNING

Clutch hydraulic fluid (DOT 4 brake fluid) is hazardous. It may be a skin irritant and can cause blindness if it gets in your eyes. Always wear safety glasses when handling clutch hydraulic fluid or bleeding hydraulic lines. If you get clutch hydraulic fluid on your skin, wash it off as soon as possible.

3. Prepare the pressure bleeding equipment according to the manufacturer's instructions. Use DOT 4 brake fluid. Pressurize the bleed adaptor to 15 psi (103 kPa).

⚠ CAUTION

Do not spill clutch hydraulic fluid (DOT 4 brake fluid) on the cab paint. Clean it off immediately if any is spilled. DOT 4 brake fluid can damage paint.

4. Remove the reservoir lid and install the pressure bleed adaptor on the reservoir.
5. Pressurize the reservoir, filling the system. Open the bleed valve on the bleed tank of the adaptor.

NOTE: A pressure bleeder hose (J-29532) and a bleed adaptor (J-35798) for the fluid reservoir are available through SPX Kent-Moore Tools and may be used to complete the following procedure. To order these parts, call Kent-Moore at 1-800-328-6657.

6. Flush the hydraulic system. See **Fig. 6**.
   - 6.1 Open the bleed screw on the slave cylinder.
   - 6.2 Using a drain pan or other suitable container, collect the fluid that drains from the slave cylinder bleed valve, at least 0.5 quarts (0.5 liters).
   - 6.3 When all the old fluid has passed through the system and only new, clean fluid is coming out, close the bleed screw.
7. Check the fluid level in the reservoir and bleed the system according to the procedures under the heading "Bleeding the Clutch." See **Fig. 7**.

Bleeding the Clutch

1. Remove the cap from the bleed valve. Install a transparent drain hose on the bleed valve of the slave cylinder.
2. Open the slave cylinder bleed screw. Observe the flow of clutch hydraulic fluid through the drain hose. When bubbles no longer appear in the fluid, close the slave cylinder bleed screw.
3. Disconnect the transparent hose. Tighten the bleed screw 88 lbf·in (1000 N·cm) and install the cap on the slave cylinder bleed valve.
4. Close the valve on the bleed tank of the pressure bleed adaptor. Remove the pressure bleed adaptor.
5. Check the fluid level in the reservoir. If necessary, add or remove clutch hydraulic fluid to bring the fluid level to the MAX line. Install the reservoir lid.

⚠ CAUTION

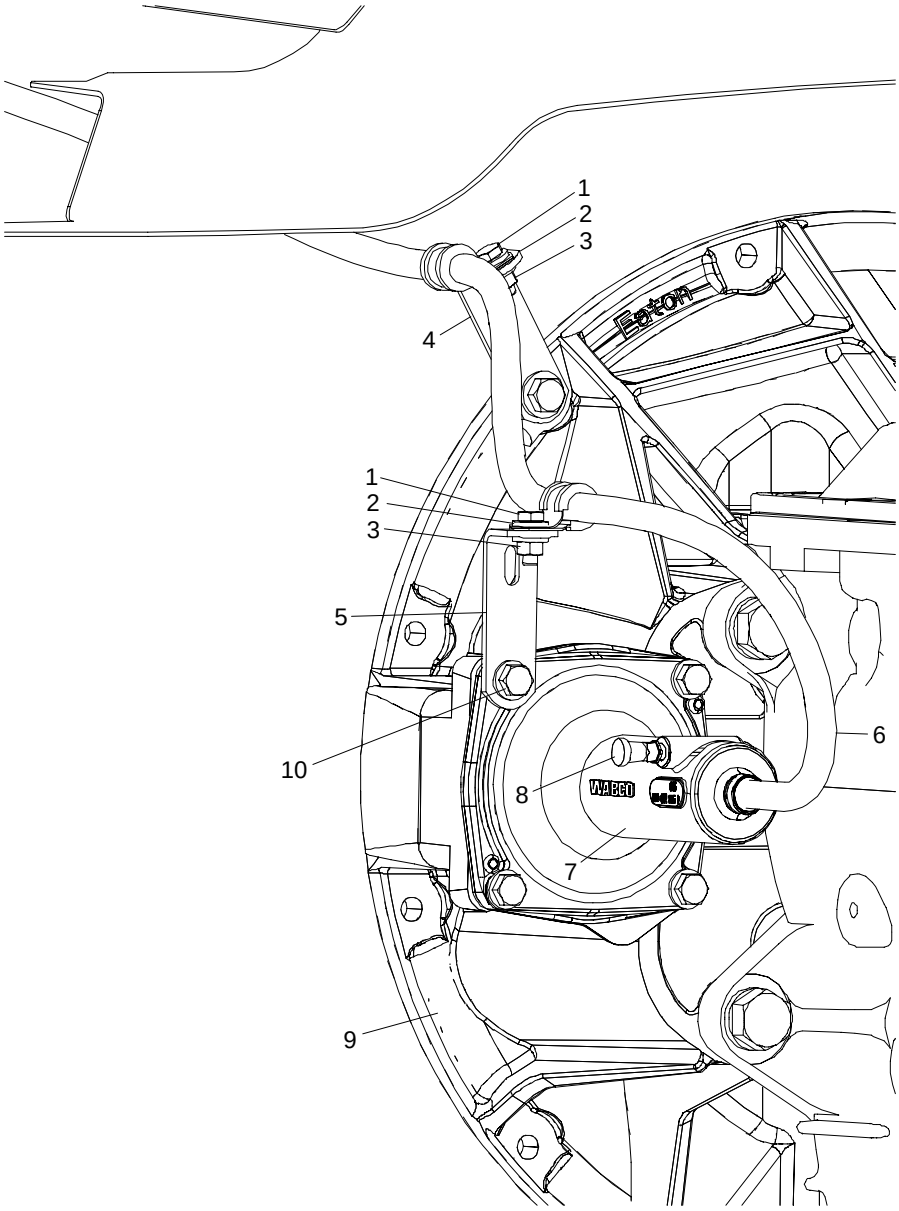
When removing fluid from the reservoir, use a clean tool that is used only for brake fluid. Using a tool contaminated with oil or chemical residue will destroy hydraulic system parts and cause the system to malfunction.

6. Depress the clutch pedal a few times. There should be resistance over the full pedal stroke.
7. Check the entire system for leaks. Tighten the connections between the components if necessary. Check the fluid level in the reservoir again.
8. Make sure the reservoir lid is tight.
9. Lower the hood and remove the chocks from the front and rear tires.

25–05 Clutch Adjusting, Manually Adjusted Clutches

NOTE: This procedure is only required for vehicles equipped with non-synchronized transmissions and manually adjusted clutches.

Release bearing travel is the clearance between the rear surface of the release bearing housing and the forward surface of the clutch brake disc. This dis-



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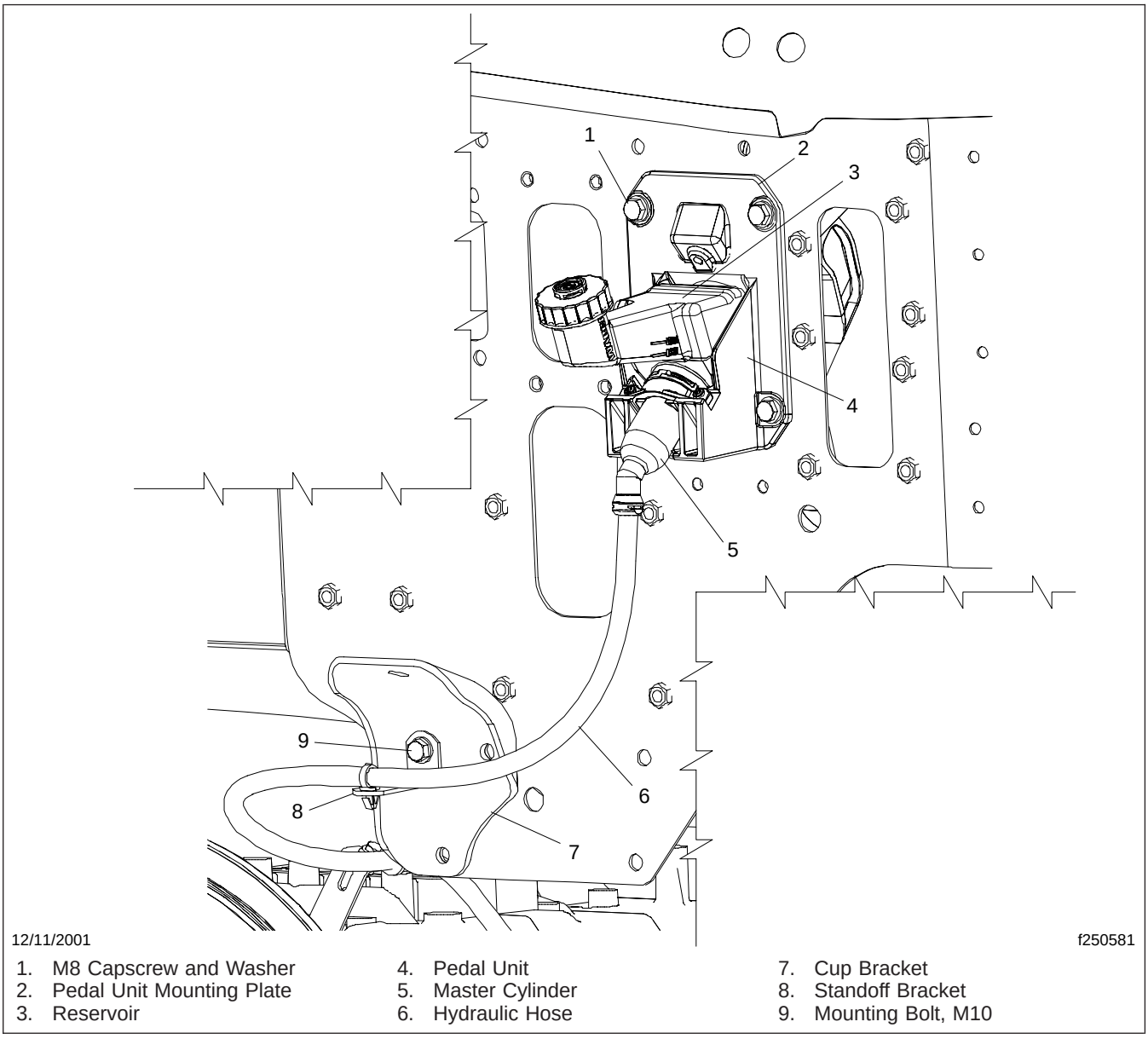
1. Clamp-Mounting Bolt, 1/4–20
2. Plated Steel Washer
3. Locknut, 1/4–20
4. Bell Housing Standoff Bracket
5. Slave Cylinder Standoff Bracket
6. Hydraulic Hose
7. Slave Cylinder
8. Bleed Valve
9. Bell Housing
10. Slave Cylinder Mounting Capscrew, M8

Fig. 6, Clutch Slave Cylinder

tance must be maintained between 1/2 and 9/16 inch (12.7 and 14.3 mm).

1. Remove the clutch inspection cover from the bell housing. See **Fig. 8**.



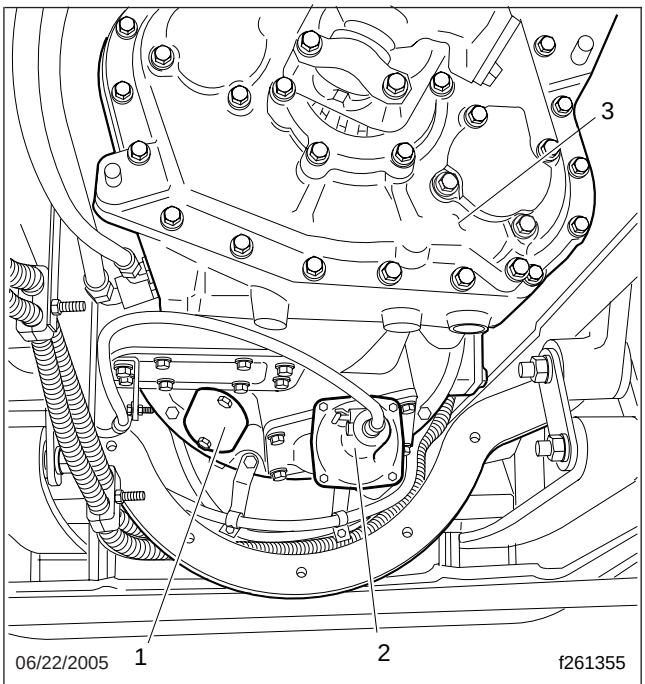
1. M8 Capscrew and Washer
2. Pedal Unit Mounting Plate
3. Reservoir
4. Pedal Unit
5. Master Cylinder
6. Hydraulic Hose
7. Cup Bracket
8. Standoff Bracket
9. Mounting Bolt, M10

Fig. 7, Clutch Master Cylinder

2. Slide the clutch brake tight against the transmission input-shaft bearing cap.

IMPORTANT: Release bearing travel tool A02-12419-000 is available through the PDCs. The fork at one end of the tool has green tape on it, and has two 0.50-inch (12.7-mm) diameter tips; the fork at the other end has blue tape on it, and has 0.56-inch (14.3-mm) diameter tips. See **Fig. 9**.

3. Measure the release bearing travel. See **Fig. 10** for the correct dimension to measure. Using both ends of the release bearing travel tool, check this gap as follows:



1. Clutch Inspection Cover
2. Hydraulic Slave Cylinder
3. Transmission

Fig. 8, View from Underneath the Vehicle

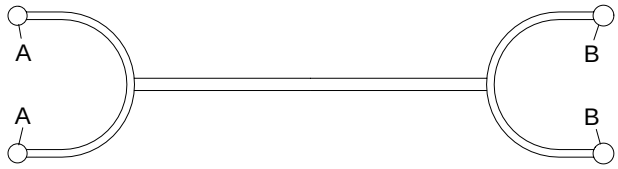
Position the tool so that the legs of the fork at the blue 0.56-inch (14.3-mm) end straddle the transmission input shaft. If the tool fits loosely, the gap is too wide and adjustment is needed. Go to the next step.

If the blue 0.56-inch (14.3-mm) end can't be inserted in the gap, then try to insert the green 0.50-inch (12.7-mm) end.

If the green end of the tool can't be inserted in the gap, adjustment is needed. Go to the next step.

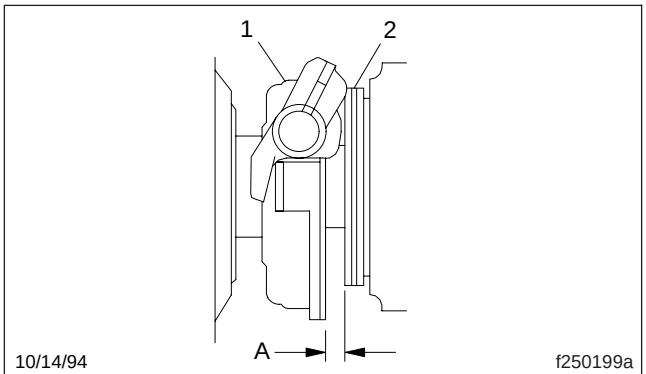
If the green end of the tool fits — snugly or loosely — then no adjustment is needed. Nothing more needs to be done. Install the clutch inspection cover.

4. Turn the engine flywheel until the lockstrap is aligned with the clutch inspection-cover opening.
5. Release the clutch by depressing the pedal. Block the pedal in the released position, or have someone assist you by holding the pedal down during the adjustment procedure.



A. Green End (0.50 inch or 12.7 mm)
B. Blue End (0.56 inch or 14.3 mm)

Fig. 9, Release Bearing Travel Tool A02-12419-000



A. Clearance between release bearing housing and clutch brake must be 1/2 to 9/16 inch (12.7 to 14.3 mm).
1. Release Bearing Housing
2. Clutch Brake

Fig. 10, Release Bearing Travel Measurement

NOTE: An open-end wrench is not recommended for the following step.

6. Adjust the clutch, using a 5/8-inch box-end or socket wrench on the adjustment bolt. See **Fig. 11**.

   6.1 Insert the 5/8-inch box-end or socket wrench through the inspection cover opening.

   6.2 To begin the adjustment, release the adjustment bolt by pressing down on the bolt head.

   NOTE: On Easy-Pedal 2000 clutches, each complete turn of the adjustment bolt represents about 0.125 inch (3 mm) of release bearing movement. On earlier Easy-Pedal models, each complete turn of the adjust-

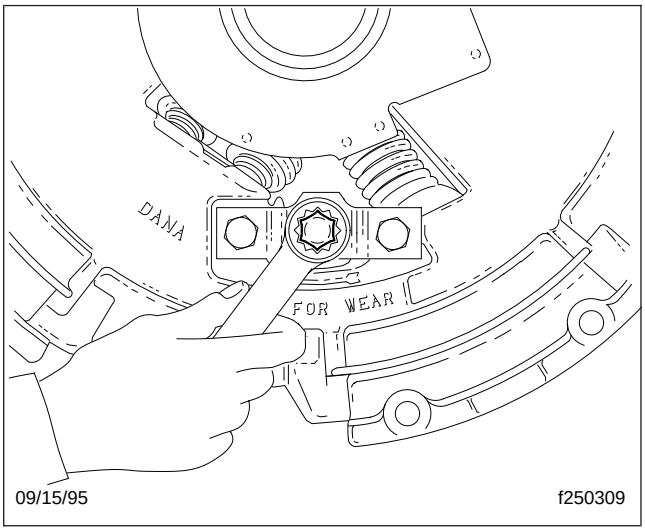


Fig. 11, Adjustment with Kwik-Adjust (shown with bell housing removed)

ment bolt represents about 0.02 inch (0.5 mm) of release bearing movement.

Normal wear increases the gap between the release bearing and the transmission.

6.3 *To decrease the gap*: If clearance between the release bearing housing and the clutch brake is *more than* 9/16 inch (14.3 mm), turn the adjustment bolt clockwise (the release bearing moves toward the transmission).

To increase the gap: If clearance between the release bearing housing and the clutch brake is *less than* 1/2 inch (12.7 mm), turn the adjustment bolt counterclockwise (the release bearing moves toward the engine).

6.4 When the adjustment is complete, make sure the adjustment bolt is locked (pulled up flush with the mounting bolts).

7. After adjusting, release the pedal and check the clearance between the release bearing housing and the clutch brake. When the adjustment is correct, the green end of the tool should go in and the blue should not (clearance of 1/2 to 9/16 inch, or 12.7 to 14.3 mm).

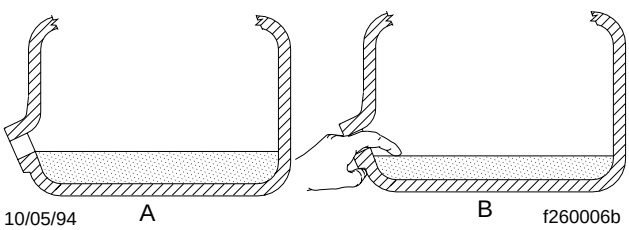
8. Install the clutch inspection cover.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Allison Transmission Fluid and Filter Changing	26–05
Allison and Eaton Fuller Transmission Breather Checking	26–03
Eaton Fuller Transmission Air Filter/Regulator Element Cleaning	26–04
Eaton Fuller Transmission Fluid Changing and Magnetic Plug Cleaning	26–02
Manual Transmission Oil Level Checking	26–01
Mercedes-Benz Transmission Fluid Changing and Magnetic Plug Cleaning	26–06
Mercedes-Benz Transmission Leak Checking	26–07

26–01 Manual Transmission Oil Level Checking

1. Park the vehicle on a level surface. Apply the parking brakes and chock the rear tires.
2. Check the oil level in the transmission. See **Fig. 1**.



A. Full B. Low

Fig. 1, Transmission Oil Level Checking

2.1 Clean the area around the fill plug, then remove the plug from the side of the case.

2.2 Using your finger or a bent pipe cleaner, see if the oil is level with the lower edge of the fill opening.

3. If needed, fill the transmission with oil until level with the lower edge of the fill opening. See **Table 1** for approved lubricants.

Approved Manual Transmission Lubricants		
Lubricant Type*	**Temperature: °F (°C)**	**SAE Viscosity**
Eaton Fuller Transmissions†		
MobilTrans SHC 50 (RN 2952 E-5)	All	50
Synthetic lubricant approved by Eaton	All	50
Heavy-duty engine oil meeting MIL-L-2104D or Caterpillar TO-4 Specification	Above 10 (–12)	40 or 50
	Below 10 (–12)	30
API MT-1 gear oils meeting MIL-PRF-2105E specification	Above 10 (–12)	80 or 90
	Below 10 (–12)	75
Mercedes-Benz Transmissions		
MobilTrans SHC® DC	All	50

* Lubricants listed in order of preference. Do not mix types of oil.

† Call 1-800-826-4357 for a complete list of Eaton approved lubricants.

Table 1, Approved Manual Transmission Lubricants

CAUTION

Operating a manual transmission with the fluid level higher or lower than recommended can result in transmission damage. Do not overfill the transmission; overfilling will force fluid out of the case through the main shaft openings. Fluid overflow may also drain onto the clutch or clutch brake, causing additional problems.

IMPORTANT: Do not mix types of oil, because of possible incompatibility. Do not use oil additives or friction modifiers. Do not use multi-viscosity oils or EP (Extreme Pressure) gear oils. If switching from a petroleum-based lubricant to a synthetic, all areas of each affected component must be thoroughly drained. Switching to a synthetic lubricant, when a petroleum-based lubricant has been used for 50,000 miles (80 000 km) or longer may affect transmission performance. Monitor all seal areas for the first 10,000 miles (16 000 km) after changing to a synthetic from a petroleum-based lubricant.

4. Clean the fill plug, then install it in the transmission. Tighten the plug as follows:
   - 25 to 35 lbf·ft (34 to 48 N·m) for Eaton Fuller transmissions with 3/4-inch pipe threads.
   - 60 to 75 lbf·ft (81 to 102 N·m) for Eaton Fuller transmissions with 1-1/4-inch pipe threads.
   - 42 lbf·ft (57 N·m) for all Mercedes-Benz transmissions.

26–02 Eaton Fuller Transmission Fluid Changing and Magnetic Plug Cleaning

Eaton Fuller has a complete listing of approved lubricants for its transmissions on its internet website. Refer to the Eaton website for additional information, **www.roadranger.com**.

Draining

IMPORTANT: Manual transmissions filled with approved synthetic lubricants require a lubricant drain and fill, and a magnetic plug cleaning every 500,000 miles (800 000 km), regardless of the service or vocation of the vehicle. Manual transmissions with petroleum-based lubricants require a lubricant drain and fill, and a magnetic plug cleaning at each Maintenance 2 (M2) interval. All transmissions, regardless of lubrication used, also require a check of the transmission breather at each Maintenance 1 (M1) interval.

1. Park the vehicle on a level surface. Apply the parking brakes and chock the rear tires.
2. Drain the fluid while the transmission is warm, as follows.
   - 2.1 Clean the area around the drain plug(s). Remove the drain plug(s) from the gear case.
   - 2.2 Clean the area around the fill plug. Remove the fill plug from the gear case.
3. Clean the magnetic plug(s) before installing it. Use a piece of key stock, or any other convenient steel slug, to short the two magnetic poles and divert the magnetic field.
4. Install and tighten the drain plug(s) 50 lbf·ft (68 N·m).

Filling

⚠ CAUTION

Operating a manual transmission with the fluid level higher or lower than recommended can result in transmission damage. Do not overfill the transmission; overfilling will force fluid out of the case through the main shaft openings. Fluid overflow may also drain onto the clutch or clutch brake, causing additional problems.

IMPORTANT: Do not mix types of fluid, because of possible incompatibility. Do not use multi-viscosity fluids or EP (Extreme Pressure) gear fluids. Do not use fluid additives or friction modifiers. If switching from a petroleum-based lubricant to a synthetic lubricant, all areas of each affected component must be thoroughly drained. Switching to a synthetic lubricant, when a petroleum-based lubricant has been used for 50,000 miles (80 000 km) or longer may affect transmission performance. Monitor all seal areas for the first 10,000 miles (16 000 km) after changing to a synthetic lubricant from a petroleum-based lubricant.

NOTE: The correct fluid level is established by checking at the fill plug opening.

1. Add fluid until it is level with the lower edge of the fill opening. See **Fig. 1**. If the transmission has two fill openings, add fluid to the level of both fill openings. See **Table 1** for approved transmission lubricants, and **Table 2** for lubricant capacities.
2. Clean the fill plug, then install it in the transmission. Tighten the plug as follows:
   - 25 to 35 lbf·ft (34 to 48 N·m) for Eaton Fuller transmissions with 3/4-inch pipe threads.
   - 60 to 75 lbf·ft (81 to 102 N·m) for Eaton Fuller transmissions with 1-1/4-inch pipe threads.

26–03 Allison and Eaton Fuller Transmission Breather Checking

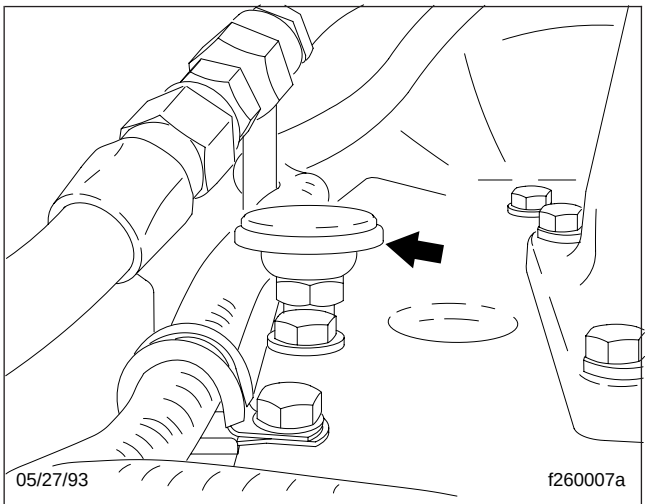
Transmission housing breathers (if equipped) must remain clear. A plugged breather could result in pressure build-up, which could cause oil leakage.

If the breather is plugged, clean or replace it. See **Fig. 2**. Check more often if the vehicle is operating under very dusty conditions.

Eaton Fuller Transmission Lubricant Capacities*	
Transmission Model	**Lubricant Capacity: qt (L)**
5-Speed	
FS–4205A/B, FS–5205A/B	6.25 (5.9)
FS–6305A/B	9.75 (9.2)
6-Speed	
FS–5406A	9.75 (9.2)
FS–6406A, FSO–6406A	9.75 (9.2)
FO–6406A, FO-8406	10.5 (10.0)
FSO–8406A	9.75 (9.2)
7-Speed	
T–14607A/B	18 (17.5)
TX–14607B	18 (17.5)
9-Speed	
RT–6609A	6 (5.7)
RT–8709B	13.0 (12.3)
RT–8608L	13.5 (12.7)
10-Speed	
FR–9210B	11.75 (11)
FRO–14210C, FRO–15210C	11.75 (11)
RT–8908LL	14 (13.2)
RTO–10910B AS2	13 (12.3)
RTO–11908LL	14 (13.2)
11-Speed	
RTO–11909ALL	14 (13.2)
13-Speed	
RTLO–14913A	14 (13.2)
18-Speed	
RTLO–14918B	14 (13.2)
RTLO–16918B	14 (13.2)

* Quantities listed are approximate. Fill the transmission until the lubricant is level with the bottom of the fill hole, with the vehicle in normal operating position.

Table 2, Eaton Fuller Transmission Lubricant Capacities



NOTE: Location of the transmission breather will vary depending on transmission model.

Fig. 2, Transmission Breather (Eaton Fuller shown)

26–04 Eaton Fuller Transmission Air Filter/ Regulator Element Cleaning

NOTE: Eaton Fuller FS/FO and T/TX transmissions do not have an air filter/regulator element that can be serviced.

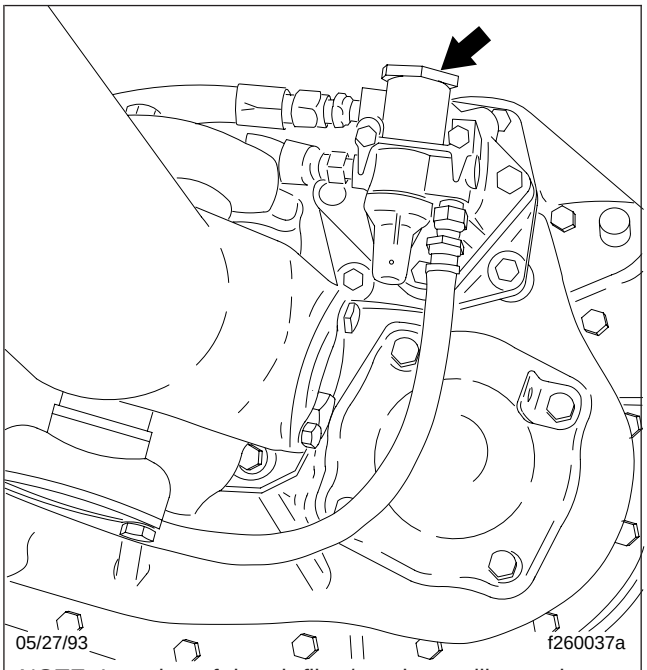
⚠ WARNING

Exhaust the air supply before servicing the air filter/regulator; otherwise, serious personal injury and component damage could result.

1. Exhaust the air from the air reservoirs.
2. Clean the outside of the air filter/regulator with cleaning solvent, then let it air dry. See **Fig. 3**.
3. Remove the end cap, large O-ring, and filter element from the filter housing. See **Fig. 4**. Remove the small O-ring from the end cap.

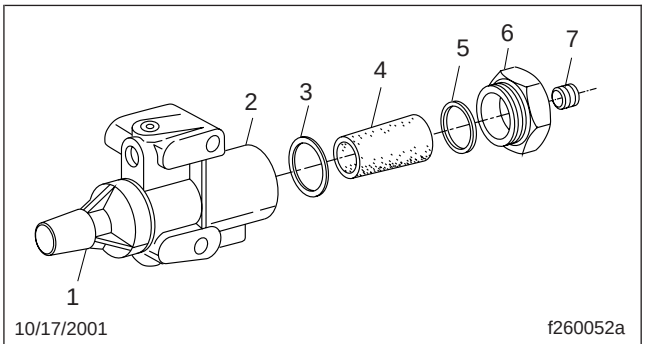
NOTE: Do not remove, disassemble, or adjust the air regulator. If the air regulator is not keeping the air pressure between 57 to 62 psi (396 to 431 kPa), replace the air filter/regulator. It cannot be repaired.

4. Clean the filter element.



NOTE: Location of the air filter/regulator will vary depending on transmission model.

Fig. 3, Eaton Fuller Transmission Air Filter/Regulator Location



1. Air Regulator
2. Housing
3. Large O-Ring
4. Filter Element
5. Small O-Ring
6. End Cap
7. Plug

Fig. 4, Eaton Fuller Transmission Air Filter/Regulator Components

4.1 Dip the filter element in alcohol or other cleaning solvent. Blow compressed air through the filter element (inside to outside) to loosen surface dirt and to dry the element. The sintered metallic filter element will last the life of the vehicle, provided it is not damaged.

4.2 Wipe out the filter housing with a clean, dry, lint-free rag.

5. Clean and inspect the O-rings and the end cap. Replace any parts that are damaged.
6. Install the large O-ring, then the filter element (small end first) into the filter housing.
7. Install the small O-ring in the end cap, then install the end cap on the filter housing. Tighten the end cap until firm.
8. Start the engine, and build pressure in the air system. Check for air leaks at the filter housing and air line connections, and repair any leaks.

⚠ CAUTION

Repair any air leaks. A leaking air filter or air lines can cause slow or hard shifting of the transmission, and eventual transmission damage.

26–05 Allison Transmission Fluid and Filter Changing

When draining transmission fluid, check for evidence of dirt or water contamination. A small amount of condensation will appear in the fluid during operation.

Water contamination is normally characterized as a milky discoloration of the transmission fluid. Obvious contamination of the transmission fluid indicates a leak between the water and fluid areas of the transmission cooler. Inspect and pressure-test the cooler to confirm the leak; replace leaking transmission coolers.

1000/2000/2400 Series

1. Park the vehicle on a level surface and apply the parking brakes.
2. Run the engine until the transmission fluid reaches the operating temperature of 160 to 200°F (71 to 93°C). Shift the transmission to neutral (N) and shut down the engine.

⚠ CAUTION

To prevent dirt from entering the transmission, use only clean containers and fillers for the transmission fluid. Do not use fillers or containers that have been used for water or antifreeze. Dirt, water, or antifreeze could damage the transmission.

3. Clean the area around the drain plug. Place a drain pan under the transmission and remove the drain plug. Examine the fluid while it drains. If only the filter is being changed, do not drain the fluid.

NOTE: A lot of fluid will drain when the filter is removed.

4. Using a standard strap-type filter wrench, remove the filter by turning it counterclockwise.
5. Remove the magnet from the filter attachment tube or from the top of the filter element.
6. Clean any metal debris from the magnet. Then, install the magnet on the filter attachment tube.
7. Using transmission fluid, lubricate the gasket on the filter.
8. Using your hand, install the filter by turning it clockwise until the filter gasket contacts the converter housing or cooler manifold. Then, turn the filter one more complete turn.
9. Install the drain plug and sealing washer. Tighten the plug 22 to 30 lbf·ft (30 to 40 N·m).
10. Clean the area around the fill tube and remove the dipstick. Using a clean funnel in the fill tube, add transmission fluid. See **Table 3** for approved transmission lubricants, and **Table 4** for lubricant capacities.
11. Check and adjust the fluid level using the procedure under "Checking the Fluid Level."

MD and HD Series

⚠ CAUTION

To prevent dirt from entering the transmission, use only clean containers and fillers for the transmission fluid. Do not use fillers or containers that have been used for water or antifreeze. Dirt, water, or antifreeze could damage the transmission.

Approved Allison Transmission Lubricants	
Lubricant Type*	**Temperature: °F (°C)**
All Allison Transmissions	
Castrol TranSynd™ (synthetic)	Above –22 (–30)
Dexron® III	Above –13 (–25)

* Lubricants listed in order of preference. Do not mix types of oil.

Table 3, Approved Allison Transmission Lubricants

Allison Transmission Lubricant Capacities	
Transmission Model	**Fill Capacity:* qt (L)**
On-Highway Transmissions	
1000/2000/2400 Series (standard sump)	15 (14)
1000/2000/2400 Series (shallow sump)	13 (12)
HD/MD Series	
HD4060/4560 (standard sump)	36 (34)†
HD4060/4560 (shallow sump)	26 (25)†
MD3060/3066/3560 (standard sump)	19 (18)
MD3060/3066/3560 (shallow sump)	10.5 (10)

* Quantities listed are approximate. Add the recommended amount of fluid as listed under fill capacity, then perform a "hot check" and add fluid as needed. Do not overfill.

† Add 3 quarts (3 liters) if equipped with a PTO.

Table 4, Allison Transmission Lubricant Capacities

1. Park the vehicle on a level surface and apply the parking brakes.
2. Operate the vehicle until the transmission reaches normal operating temperature: 160 to 200°F (71 to 93°C).
3. Clean the area around the drain plug and the transmission fluid pan. Place a drain pan under the transmission and remove the drain plug. Examine the fluid as it drains. If only the filter is being changed, do not drain the fluid.
4. Remove the 12 mounting bolts (six each) from the two filter covers.

NOTE: A lot of fluid will drain when the filter covers are removed.

5. Remove the filter covers, O-rings, and two square-cut seals from the transmission. See **Fig. 5**.

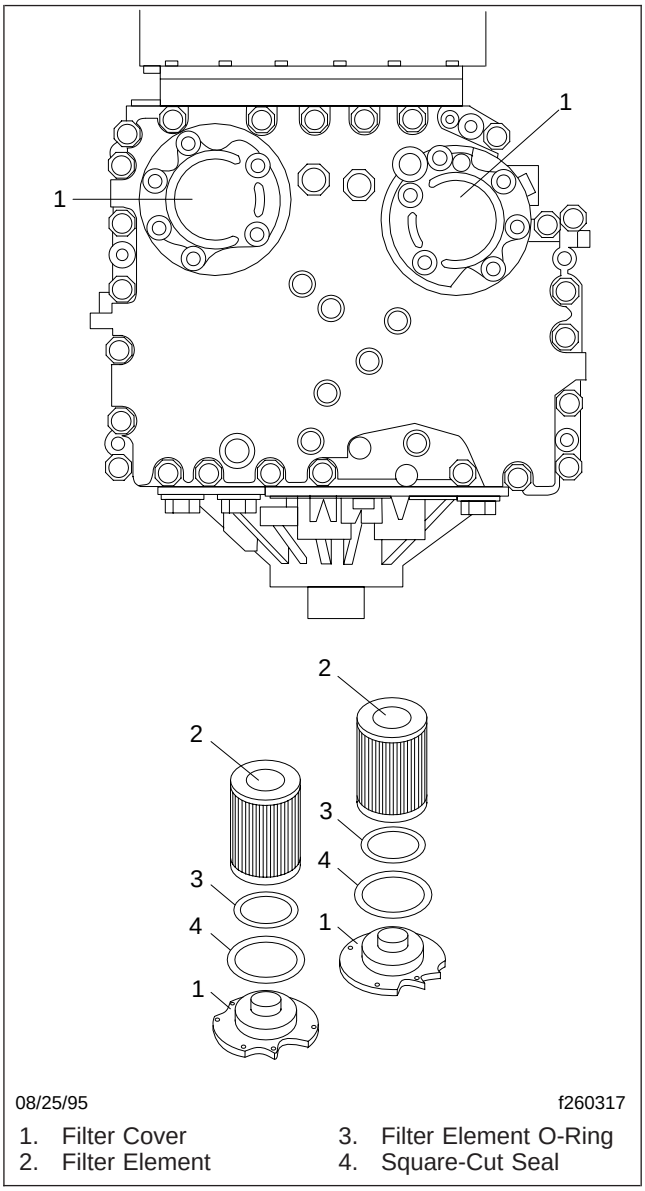


Fig. 5, Allison MD and HD Series Transmission Filter Locations and Components

6. Remove the filters from the bottom of the control module.
7. Lubricate the new O-rings with transmission fluid, and install them on the cover assemblies.
8. Install a new square-cut seal on each cover assembly, and install the fluid filter elements on the cover assemblies.
9. Install the filter and cover assemblies into the filter compartment.
10. Align each cover assembly with the holes in the channel plate sump, and push the cover assemblies in by hand to seat the seals.

CAUTION

Do not use the bolts to draw the filter covers to the sump. This can damage the covers, seals, or sump.

11. Install six bolts in each cover, and torque the bolts 38 to 44 lbf·ft (51 to 61 N·m).
12. Install a new drain plug O-ring, and install the drain plug. Tighten the drain plug 18 to 24 lbf·ft (25 to 32 N·m).
13. Refill the transmission with fresh Dexron® transmission fluid (see **Table 3**) and check the fluid level. See **Table 4** for lubricant capacities.
14. Check and adjust the fluid level using the procedures under "Checking the Fluid Level."

Checking the Fluid Level

CAUTION

Operating a transmission with the fluid level higher or lower than recommended can result in transmission damage. Do not overfill the transmission.

Do not mix types and brands of fluid, because of possible incompatibility. Do not use fluid additives, friction modifiers, extreme-pressure gear fluids, or multiviscosity lubricants.

Cold Check

Clean all dirt away from around the end of the fluid fill tube before removing the dipstick.

CAUTION

Do not allow foreign matter to enter the transmission. Dirt or foreign matter in the hydraulic system may cause undue wear of transmission parts, make valves stick, and clog passages.

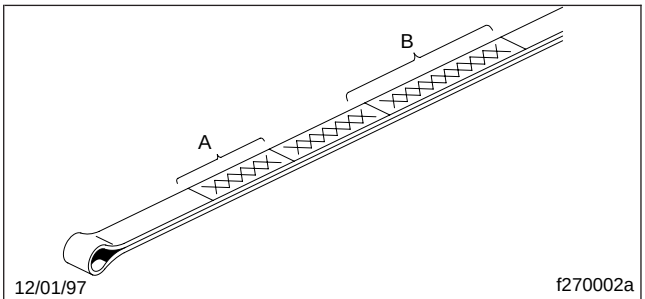
It is important to check the fluid level cold to determine if the transmission has a sufficient amount of

fluid to be safely operated until a hot check can be performed.

1. Park the vehicle on a flat, level surface.
2. Apply the parking brakes and chock the rear tires.
3. Run the engine for at least one minute.
4. Shift from DRIVE to NEUTRAL, and then shift to REVERSE to fill the hydraulic system.
5. Shift to NEUTRAL and allow the engine to idle at 500 to 800 rpm.
6. With the engine running at idle, remove the dipstick from the tube and wipe it clean.
7. Insert the dipstick into the tube, then remove the dipstick.
8. Check the fluid level reading and repeat the check procedure to verify the reading.

   If the fluid level is within the COLD RUN band, the transmission may be operated until the fluid is hot enough to perform a HOT RUN check.

   If the fluid level is not within the COLD RUN band, add or drain fluid as needed to adjust the fluid level to the middle of the COLD RUN band. See **Fig. 6**.



A. Cold Run Band B. Hot Run Band

Fig. 6, Dipstick Markings

CAUTION

Do not fill above the COLD RUN band if the transmission fluid is below normal operating temperature. As fluid temperature increases, so does the fluid level. Filling above the COLD RUN band when the transmission is below normal operating temperature may result in an overfilled transmission, which causes fluid foaming and aeration.

Fluid foaming and aeration cause transmission overheating and erratic shifting.

NOTE: Perform a hot check at the first opportunity after the normal operating temperature, 160 to 200°F (71 to 93°C) has been reached.

Hot Check

1. Park the vehicle on a flat, level surface. Apply the parking brakes and chock the rear tires.
2. Shift the transmission to NEUTRAL.
3. Operate the engine at idle (500 to 800 rpm) until normal operating temperature is reached. Check that the sump temperature is 160 to 200°F (71 to 93°C). Check that the converter-out temperature is 180 to 220°F (82 to 104°C).
4. With the engine idling, remove the dipstick from the tube and wipe it clean.
5. Insert the dipstick into the tube, then remove it.
6. Check the fluid level reading and repeat the check procedure to verify the reading. Safe operating level is within the HOT RUN band on the dipstick. The HOT RUN band is between the HOT FULL and HOT ADD marks.

   If the fluid level is not within the HOT RUN band, add or drain fluid as needed to bring the fluid level within the HOT RUN band. See **Fig. 6**.

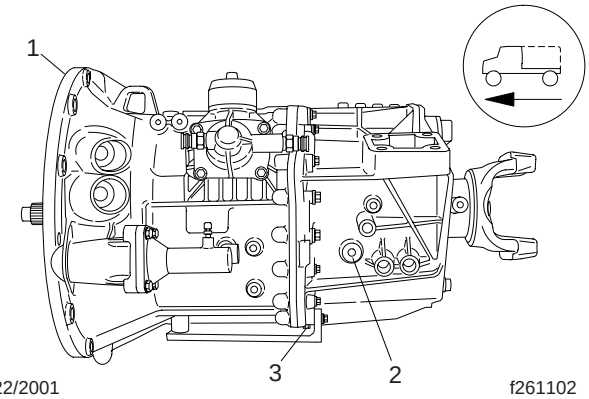
26–06 Mercedes-Benz Transmission Fluid Changing and Magnetic Plug Cleaning

Draining

1. Park the vehicle on a level surface. Apply the parking brakes and chock the rear tires.

NOTE: Drain the transmission fluid while the transmission is warm.

2. Drain the transmission fluid, as follows. See **Fig. 7**.
   - 2.1 Remove the magnetic drain plug from the bottom of the gear case.
   - 2.2 Discard the aluminum gasket.



NOTE: The transmission is shown from the left-hand side.

1. Transmission
2. Fill Plug
3. Drain Plug

Fig. 7, MBT Drain and Fill Plugs

2.3 Catch the transmission fluid in a suitable container and dispose of it properly.

3. Clean the area around the fill plug. See **Fig. 7** for the location of the fill plug
4. Remove the fill plug from the side of the case. Discard the aluminum gasket.

NOTE: Use a piece of key stock, or any other convenient steel slug, to short the two magnetic poles and divert the magnetic field.

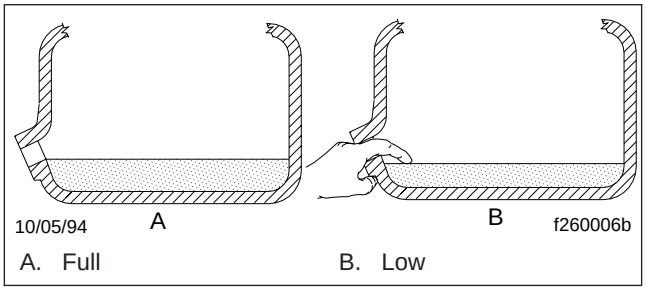
5. Clean the magnetic drain plug before installing it.
6. Install the drain plug (p/n A 124 997 01 32) and a new aluminum gasket (p/n N 00763 024105). Tighten the drain plug 42 lbf·ft (57 N·m).

Filling

⚠ CAUTION

Operating a manual transmission with the fluid level higher or lower than recommended can result in transmission damage. Do not overfill the transmission; overfilling will force fluid out of the case through the main shaft openings. Fluid overflow may also drain onto the clutch or clutch brake, causing additional problems.

1. Add transmission fluid until it is level with the lower edge of the fill opening. See **Fig. 8** for the correct level. See **Table 5** for approved transmission lubricants and **Table 6** for lubricant capacities.



A. Full B. Low

Fig. 8, MBT Fluid Level Checking

MB Transmission Lubricant Types	
Manufacturer	**Type**
Mobil	Mobiltrans SHC® DC

Table 5, MB Transmission Lubricant Types

MB Transmission Lubricant Capacities	
Transmission Model	**Refill Capacity:* qt (L)**
MBT660S-6O	9.5 (9.0)
MBT520S-6D	9.5 (9.0)

* Quantities listed are approximate. Fill the transmission until the lubricant is level with the bottom of the fill hole, with the vehicle in normal operating position.

Table 6, MB Transmission Lubricant Capacities

⚠ CAUTION

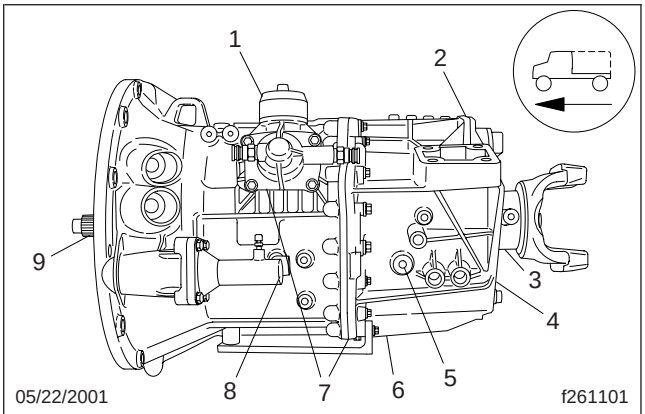
Use only the approved Mobiltrans SHC® DC fluid. Do not mix fluid types. Adding Mobiltrans SHC 50 RN 2952 E-5 fluid (used in Eaton and Meritor transmissions) could damage the radial seals.

2. Clean the fill plug before installing it.
3. Install the fill plug (p/n N000908 020001) and a new aluminum gasket (p/n N 00763 024105). Tighten the fill plug 42 lbf·ft (57 N·m).

26–07 Mercedes-Benz Transmission Leak Checking

1. Park the vehicle on a level surface. Apply the parking brakes and chock the rear tires.

2. Check for signs of leakage at the breather. See **Fig. 9**.



NOTE: The transmission is shown from the left-hand side.

1. Shift Lever Cap Seal
2. Breather
3. Output Shift Radial Seal
4. Countershaft Cover Plate
5. Transmission Fluid Fill Plug
6. Transmission Fluid Drain Plug
7. Gear Case Seals
8. Clutch Slave Cylinder
9. Input Shaft Radial Seal

Fig. 9, MBT Leak Check

2.1 If leakage is found, check the breather for a missing cap. Replace the cap if necessary.

2.2 Check the fluid level at the fill plug. If the level is too high, correct the fluid level.

3. Check for signs of leakage at the cap seal on the shift lever. If the cap seal is damaged, replace it.

4. Check for signs of leakage at the radial seal on the output shaft. If leakage is found, remove the output yoke (end yoke) and replace the seal. For procedures, see **Section 26.02, Subject 120** of the *Business Class® M2 Workshop Manual*.

NOTE: There are two cover plates on the countershaft, one at the front and one at the rear.

5. Check for signs of leakage at the rear cover plate on the countershaft (next to the output yoke). If leakage is found, check the torque on the cover-plate bolts and check the flat seal for damage.

5.1 If the flat seal is damaged, replace it.

5.2 If the cover-plate bolts are too loose, tighten them 18 lbf·ft (25 N·m). If the cover-plate bolts are too tight, replace the flat seal and tighten to 18 lbf·ft (25 N·m).

6. Check for signs of leakage at the transmission fluid fill plug. If leakage is found, check the torque on the plug and check the aluminum gasket for damage.

6.1 If the gasket is damaged, replace it.

6.2 If the fill plug is too loose, tighten it 42 lbf·ft (57 N·m). If the fill plug is too tight, loosen it, then tighten it to 42 lbf·ft (57 N·m).

7. Check for signs of leakage at the transmission fluid drain plug. If leakage is found, check the torque on the plug and check the aluminum gasket for damage.

7.1 If the gasket is damaged, replace it.

7.2 If the drain plug is too loose, tighten it 42 lbf·ft (57 N·m). If the plug is too tight, loosen it, then tighten it to 42 lbf·ft (57 N·m).

8. Check for fluid dripping at the gear case seals. If substantial leakage is found at either location, replace the transmission.

NOTE: Weeping or sweating seals are not cause for transmission replacement.

⚠ WARNING

Clutch hydraulic fluid (DOT 4 brake fluid) is hazardous. It may be a skin irritant and can cause blindness if it gets in your eyes. Always wear safety glasses when handling clutch hydraulic fluid or bleeding hydraulic lines. If you get clutch hydraulic fluid on your skin, wash it off as soon as possible.

9. Check for signs of leakage at the clutch slave cylinder.

⚠ CAUTION

Do not spill clutch hydraulic fluid (DOT 4 brake fluid) on the cab paint. Clean it off immediately if any is spilled. DOT 4 brake fluid can damage paint.

9.1 If leakage is found on the slave cylinder body, check the fittings and hose for damage.

9.2 If leakage is found on the piston seals, replace the slave cylinder and bleed the clutch hydraulic system. For detailed instructions, see **Group 25** of the *Business Class® M2 Workshop Manual*.

9.3 If the slave cylinder fittings and/or the hose are damaged, replace them.

9.4 Check the torque on the slave cylinder mounting capscrews. Tighten them 13 lbf·ft (18 N·m).

9.5 If any leakage of clutch hydraulic fluid is found, check the fluid level in the reservoir, and add fluid if needed. For detailed procedures, see **Group 25** of this manual.

NOTE: There are two cover plates on the countershaft, one at the front and one at the rear.

10. Check for signs of leakage at the clutch bell housing. If leakage is found, check the radial seal on the input shaft, the front cover plate on the countershaft (inside the clutch bell housing), and the rear radial seal on the crankshaft.

10.1 If the radial seal on the input shaft is leaking, replace the radial seal. For procedures, see **Section 26.02, Subject 120** of the *Business Class® M2 Workshop Manual*.

10.2 If the cover plate on the countershaft is leaking, replace the cover plate. Apply liquid gasket (Loctite 518) to the new cover plate when installing it.

10.3 If the rear radial seal on the engine crankshaft is leaking, replace the rear radial seal. For procedures, see the engine manufacturer's manual.

11. Remove the chocks from the tires.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Fifth Wheel Inspecting	31–02
Fifth Wheel Lubricating	31–03
Frame Fastener Torque Checking	31–01
Trailer Electrical Connector Lubricating	31–04

31–01 Frame Fastener Torque Checking

Frame brackets and components secured with Huckbolt® fasteners do not require a torque check, however, they should be inspected for damage. Frame brackets and components secured with conventional bolts and nuts are to be checked at initial maintenance (IM).

Check the torque of frame fasteners to offset the effects of bedding in or seating. When possible, always check the torque of the nut, not the bolt head. This will give a true torque reading by eliminating bolt body friction.

When checking the torque of frame fasteners, inspect the frame for cracks and other damage. Set a click-type torque wrench to the maximum torque of the fastener you are checking. Apply pressure until the torque wrench clicks. Do not loosen the bolt to check the torque. See the applicable torque table in **Group 00** for torque specifications.

NOTICE

Make sure frame fasteners are properly tightened. Continued vehicle operation with loose fasteners could result in bracket or frame damage.

NOTE: Engine supports on vehicles built from January 2007 do not require checking.

Inspect the fasteners at the following locations:

- axle stops
- equalizer brackets
- engine trunnion supports
- exhaust brackets
- fifth wheel legs
- fifth wheel mountings
- frame crossmembers and gussets
- front frame brackets
- front suspension spring brackets
- fuel tank brackets
- radius rods
- rear suspension spring brackets
- rear engine supports
- shock absorbers
- all other frame fasteners

Any component that shows signs of cracking or damage must be repaired or replaced. See the applicable group in the *Business Class® M2 Workshop Manual* for repair or replacement information.

31–02 Fifth Wheel Inspecting

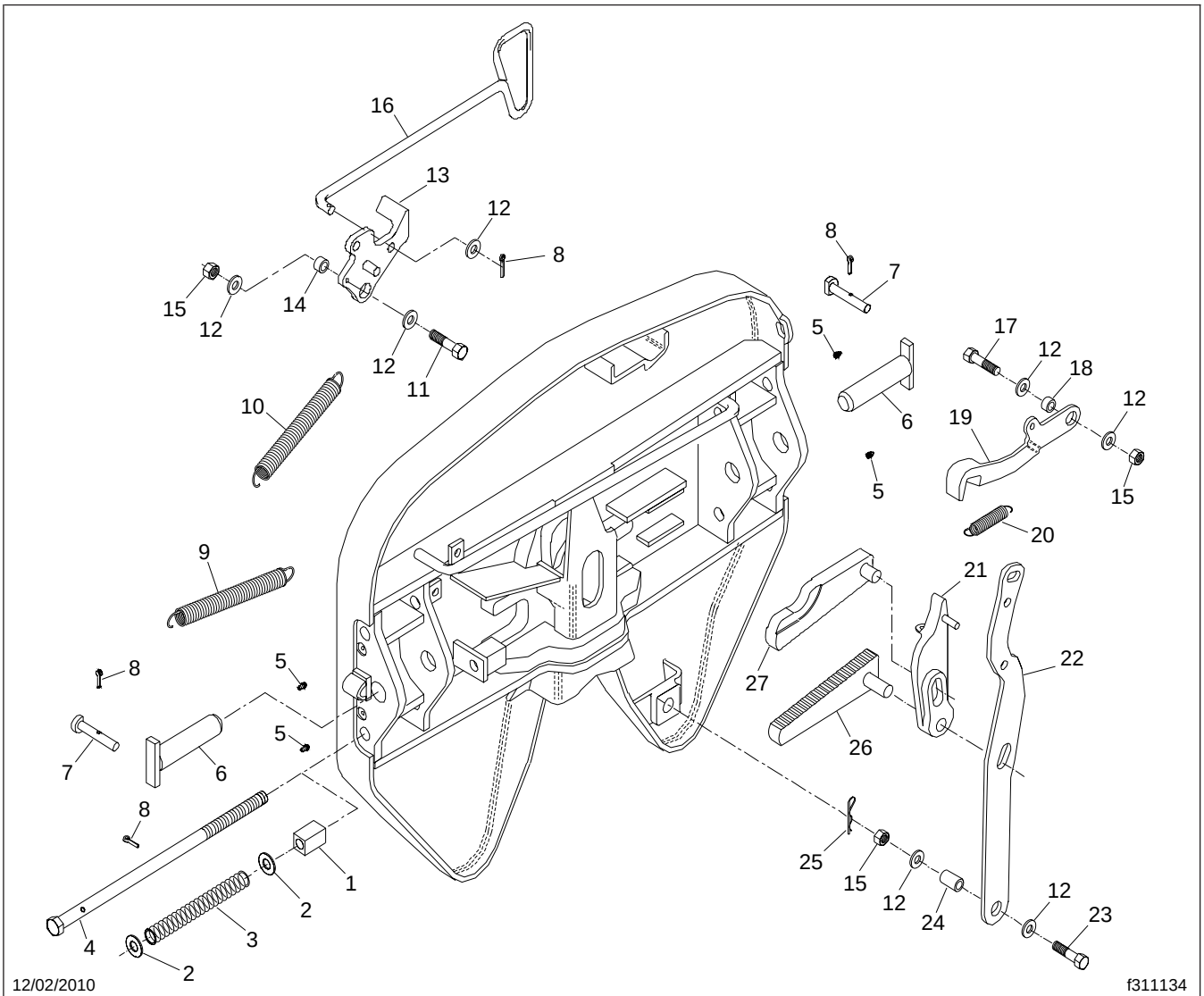
⚠ WARNING

All fifth wheel maintenance, adjustment, and rebuilding must be done only by a qualified mechanic. Improper or incomplete procedures could result in a possible disengagement of the trailer from the tractor, which could result in personal injury or property damage.

Parts are under spring compression. Wear safety goggles while servicing the fifth wheel. Failure to do so can result in personal injury, due to parts ejecting with force.

Fontaine

1. Disconnect the tractor from the trailer. For instructions, see the *Business Class M2 Driver's Manual*.
2. Thoroughly steam clean the fifth wheel.
3. Check for cracks in the fifth wheel assembly, mounting brackets, and mounting parts.
4. Ensure that both bracket pins are in place and secured by retainer pins and cotter pins. See **Fig. 1**.
5. For fifth wheels equipped with bracket liners, rock the fifth wheel. If it does not rock freely, remove the top plate and inspect the bracket liners. Replace liners that are broken or less than 0.125 inch (3 mm) thick at the top of the liners. For the liner replacement procedure, see the Fontaine website, **www.fifthwheel.com**.
6. Check the jaw and stationary jaw for mushrooming, and check that the serrations at the jaw and wedge are in good condition.
7. Test the secondary safety lock latch for ease of operation.



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NOTE: 6000 Series shown; 7000 Series fifth wheels use similar parts.

1. Wedge Stop Rod Nut
2. Flat Washer, 5/8"
3. Wedge Stop Rod Spring
4. Wedge Stop Rod
5. Grease Fitting
6. Bracket Pin
7. Bracket Retainer Pin
8. Cotter Pin, 3/16" x 1"
9. Bumper Spring
10. Handle Spring
11. Bolt, Secondary Safety Lock
12. Flat Washer
13. Secondary Safety Lock
14. Bushing, Secondary Safety Lock
15. Hex Locknut
16. Pull Handle
17. Bolt, Bumper
18. Bushing
19. Bumper
20. Timer Spring
21. Timer
22. Operating Handle
23. Bolt, Operating Handle
24. Bushing, Operating Handle
25. Hair Pin Cotter
26. Wedge
27. Step Jaw

Fig. 1, Fontaine Fifth Wheel

8. Check for loose nuts or bolts on the fifth wheel and the mounting. Set a torque wrench to the maximum torque value for the bolt being checked, and confirm that the torque is to specification. Do not loosen the bolt to check the torque. See **Group 00** for bolt torque specifications.
9. Check all springs to see if they are securely fastened, and are not deformed.

⚠ WARNING

Do not disassemble the fifth wheel to inspect the springs. The springs are under extreme pressure, and could cause serious injury.

10. Check wedge adjustment.
    - 10.1 Open the kingpin lock, and vertically insert a 2-inch (50-mm) diameter shaft.
    - 10.2 Release the lock by tripping the release latch at the bottom of the throat.
    - 10.3 Adjust the wedge stop at the end of the wedge to approximately 1/4-inch (6-mm) clearance by turning the wedge stop rod located on the right side of the top plate.
11. Replace cracked, worn, or damaged parts with new parts. Replace all loose mounting bolts with 5/8–11 SAE grade 8 bolts, grade C locknuts, and hardened washers. *Do not* re-use bolts, nuts, and washers on fifth wheel mountings.
12. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. Apply a generous coating of grease to the top plate to fill the grooves, or depressions, on the top plate. See **MOP 31–03** for lubrication instructions.

ConMet Simplex®

1. Disconnect the tractor from the trailer. For instructions, see **Chapter 10** of the *Business Class® M2 Driver's Manual*
2. Thoroughly steam-clean the fifth wheel.
3. Check the fifth wheel plate for cracks. Check for sharp edges on top; the chamfer should be 1/8 to 1/4 inch (3 to 6 mm).
4. When the wheel is locked, the safety latch must swing free and fall freely into position. See **Fig. 2**.

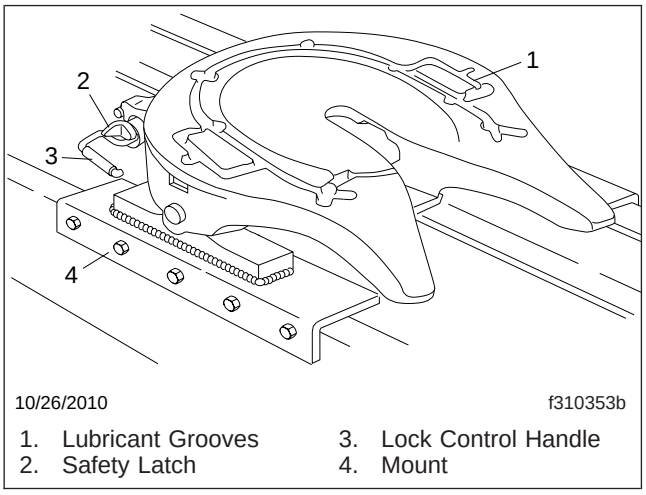


Fig. 2, Simplex Series Fifth Wheel

5. The lever bar and operating handle must be in proper alignment. See **Fig. 3**. Replace any bent or misaligned lever bar or operating rod.

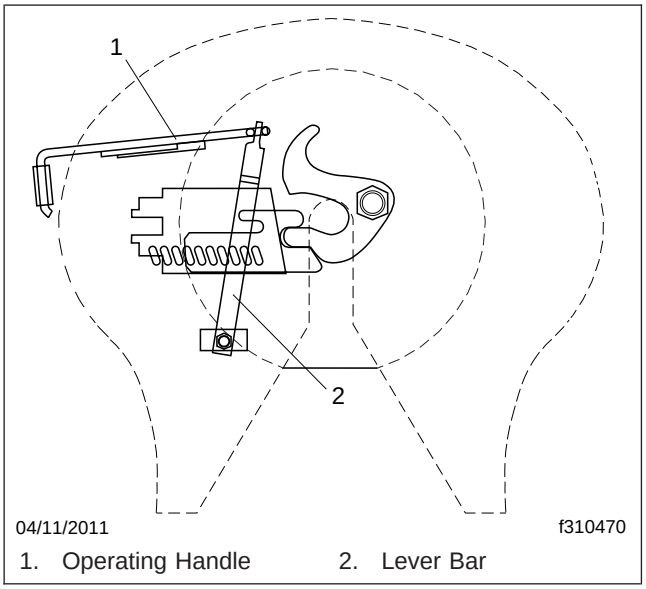
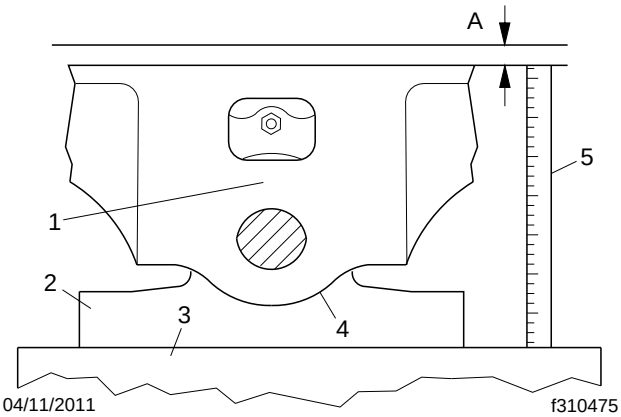


Fig. 3, Lever Bar and Operating Handle Alignment

6. Check all clinch pins for cracking or damage. Replace any clinch pin that shows signs of damage.
7. Measure the top plate lift. See **Fig. 4**.
    - 7.1 Level the fifth wheel plate to a horizontal position.



A. Extended Top Plate Lift Height
1. Fifth Wheel Top Plate
2. Fifth Wheel Frame Mount
3. Frame Rail
4. Lifting Point
5. Static Top Plate Height

Fig. 4, Measuring Fifth Wheel Top Plate Lift

7.2 Measure the height from a stationary mounting point, such as the frame rail to the top of the fifth wheel plate.

7.3 Pry up on the fifth wheel plate below the pin boss, and measure the vertical movement.

NOTE: The bracket connection provides a 9/32-inch (7-mm) vertical clearance to provide cushioning and to avoid downward pin-loading while retaining minimum plate lift.

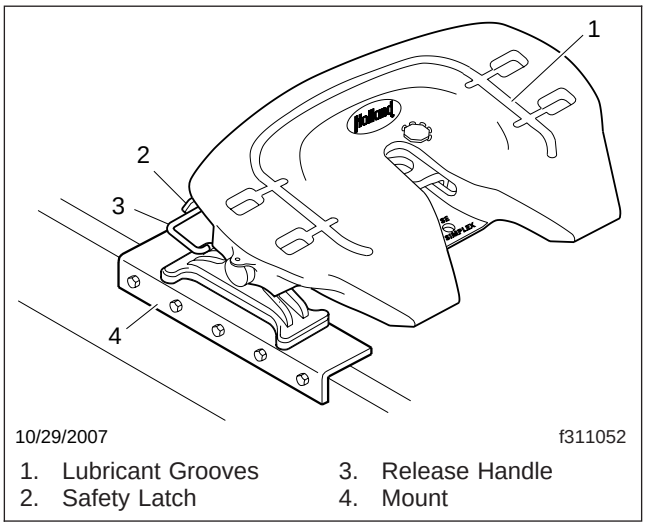
7.4 If the plate lift exceeds 5/16 inch (8 mm) as a result of wear or rubber deterioration, install new, standard or oversized bracket-shoe rubber pads; see the *Simplex Fifth Wheel Operating and Maintenance Manual* for replacement instructions.

NOTE: Do not measure plate lift immediately after a trailer has been uncoupled from the fifth wheel. The rubber may have taken a temporary set, which will normally recover after being uncoupled for a short period of time.

8. Check the clearance between the kingpin and the jaw of the fifth wheel. If the clearance is greater than 1/8 inch (3 mm), dial out the slack using the eccentric jaw pin. For detailed instructions, see the *Simplex Fifth Wheel Operating and Maintenance Manual*.
9. Check all mounting bolts for signs of fatigue, and tighten them to the proper torque. For torque specifications, see **Group 00**. Inspect all angles, plates, and brackets for cracks or other damage.
10. Replace cracked, worn, or damaged parts with new parts. Replace all loose mounting bolts with 5/8–11 SAE grade 8 bolts, grade C locknuts, and hardened washers. *Do not* re-use bolts, nuts, and washers on fifth wheel mountings.
11. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. See **Maintenance Operation 31–03** for lubrication instructions.

Holland FWS1

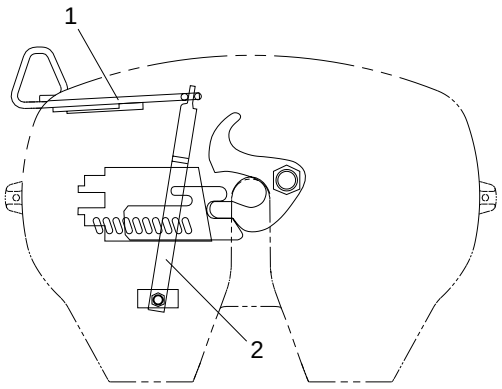
1. Disconnect the tractor from the trailer. For instructions, see the *Business Class M2 Driver's Manual*.
2. Thoroughly steam clean the fifth wheel.
3. Check the fifth wheel plate for cracks. Check for sharp edges on top; the chamfer should be 1/8 to 1/4 inch (3 to 6 mm).
4. When the wheel is locked, the safety latch must swing free and fall freely into position. See **Fig. 5**.



1. Lubricant Grooves
2. Safety Latch
3. Release Handle
4. Mount

Fig. 5, Holland FWS1 Fifth Wheel

5. The lever bar and release handle must be in proper alignment. See **Fig. 6**. Compare the lever bar and release handle alignment to a new, or a properly operating lever bar and release handle. Replace any bent or misaligned lever bar or release handle.



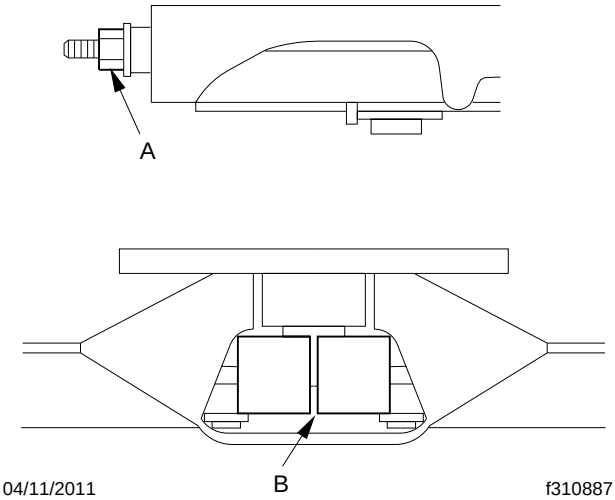
1. Release Handle 2. Lever Bar

Fig. 6, Lever Bar and Release Handle Alignment

6. Check all cotter pins for cracking or damage. Replace any cotter pin that shows any signs of damage.
7. Check all mounting bolts for signs of fatigue, and tighten them to the proper torque. For torque specifications, see **Group 00**. Inspect all angles, plates, and brackets for cracks or other damage.
8. Replace cracked, worn, or damaged parts with new parts. Replace all loose mounting bolts with 5/8–11 SAE grade 8 bolts, grade C locknuts, and hardened washers. *Do not* re-use bolts, nuts, and washers on fifth wheel mountings.
9. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. See **MOP 31–03** for lubrication instructions.

Holland FW35

1. Disconnect the tractor from the trailer. For instructions, see the *Business Class M2 Driver's Manual*.
2. Thoroughly steam clean all fifth wheel components before inspection.
3. Check for cracks in the fifth wheel assembly, mounting brackets, and mounting parts.
4. Check the fastener torques on the fifth wheel assembly and fifth wheel mounting. Tighten bolts and nuts as needed. Replace missing or damaged bolts.
5. Inspect the fifth wheel for bent, worn, damaged, and missing parts; replace them as needed with genuine Holland parts.
6. Using a Holland Kingpin Lock Tester (Holland tool number TF-TLN-5001, available through the PDCs as HLD TFTLN5001), check the operation of the locking mechanism by opening and closing the locks. See **Fig. 7**.
7. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. See **MOP 31–03** for lubrication instructions.



A. The nut and washer should be snug against the fifth wheel.
B. The locks should be completely closed around the kingpin.

Fig. 7, Holland Fifth Wheel Properly Closed

Jost

1. Disconnect the tractor from the trailer. For instructions, see the *Business Class M2 Driver's Manual*.
2. Thoroughly steam clean the fifth wheel.
3. Check the mounting for missing or damaged fasteners, and broken components. Replace or repair as needed.

4. Inspect the bracket pin bolts. Make sure the locking tabs are properly securing the bolts in place. See **Fig. 8**.

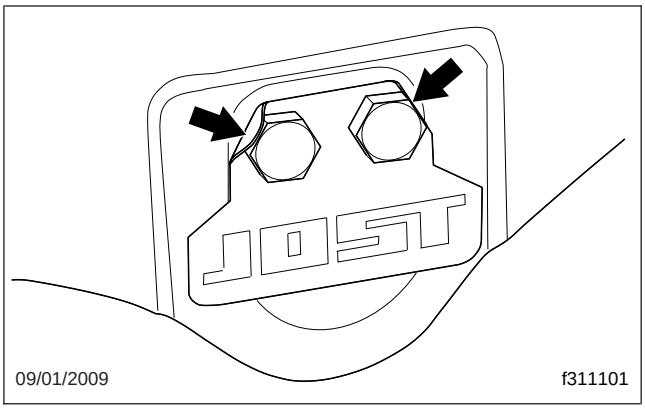


Fig. 8, Bracket Pin Bolt Locking Tabs

5. Check the fifth wheel for bent, worn, or broken parts. Replace as needed.
6. If the fifth wheel is equipped with low-lube plates, check the plates and replace if damaged or worn down to the securing bolts. It is normal for outside edges of the plate to pucker slightly; this does not affect performance.
7. Check the fifth wheel adjustment. Using a lock tester, lock and unlock the fifth wheel several times. Make sure that the locking mechanism works properly.

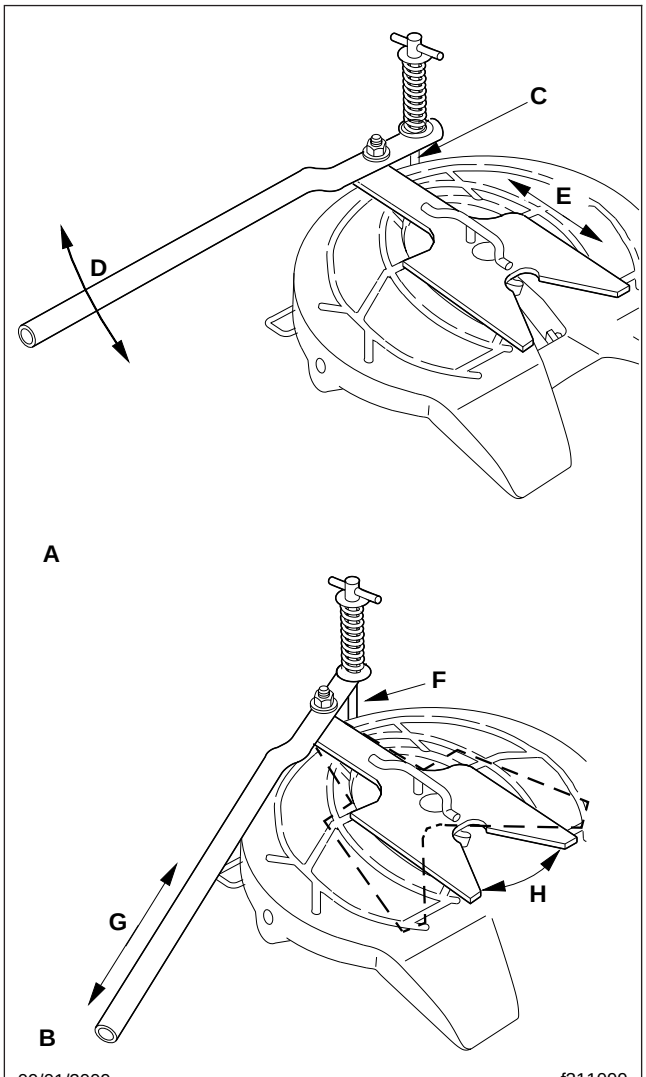
   The lock is properly adjusted if: the wheel locks and unlocks easily each time and the lock tester rotates freely.

   The lock is too loose if: you feel fore-aft play when pulling and pushing on the lock tester handle. See **Fig. 9**, Ref. A.

   The lock is too tight if: the lock tester does not rotate freely in the lock. See **Fig. 9**, Ref. B.
8. If the lock is improperly adjusted, correct as follows.

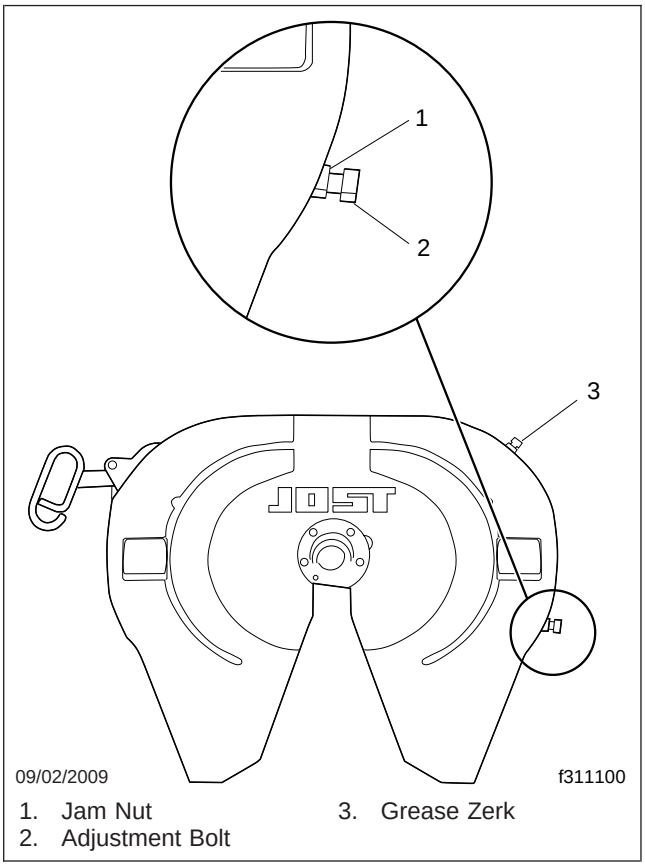
   If the lock is too tight, loosen the jam nut, turn the adjustment bolt *clockwise* one full turn, then reset the jam nut. Lock and unlock the mechanism several times to test. Repeat if necessary. See **Fig. 10**.

   If the lock is too loose, loosen the jam nut, turn the adjustment bolt *counterclockwise* one full turn, then reset the jam nut. Lock and unlock the mechanism several times to test. Repeat if necessary. See **Fig. 10**.
9. If the fifth wheel is equipped with a sliding mechanism, inspect and adjust it as follows.



A. Checking for fore/aft play.
B. Rotating tester in lock.
C. Engage hook.
D. Pull/push handle fore/aft.
E. Check for movement of kingpin in lock.
F. Disengage hook.
G. Push/pull handle inboard/outboard.
H. Rotate lock tester.

Fig. 9, Jost Fifth Wheel Adjustment



1. Jam Nut
2. Adjustment Bolt
3. Grease Zerk

Fig. 10, Jost Fifth Wheel

9.1 Check the bracket for any cracks or missing and damaged parts.

9.2 Inspect the locking plungers for full engagement.

9.3 Check the locking mechanism for proper operation.

If the plungers will not release, check the air cylinder or plunger adjustment.

If the plungers are loose, check the plunger adjustment and the plunger springs for proper compression. Replace if needed.

9.4 The outboard slider assembly requires no adjustment. If the plungers are loose, inspect and replace locking mechanism parts as needed.

9.5 The inboard slider is adjustable for frame width and plunger engagement. For adjustment, refer to the fifth wheel installation instructions.

10. Replace cracked, worn, or damaged parts with new parts. Replace all loose mounting bolts with 5/8–11 SAE grade 8 bolts, grade C locknuts, and hardened washers. *Do not* re-use bolts, nuts, and washers on fifth wheel mountings.
11. After inspecting the fifth wheel, lubricate all moving parts with a chassis or multipurpose grease. Apply a generous coating of grease to the top plate to fill the grooves, or depressions, on the top plate. See **MOP 31–03** for lubrication instructions.

31–03 Fifth Wheel Lubricating

Fontaine

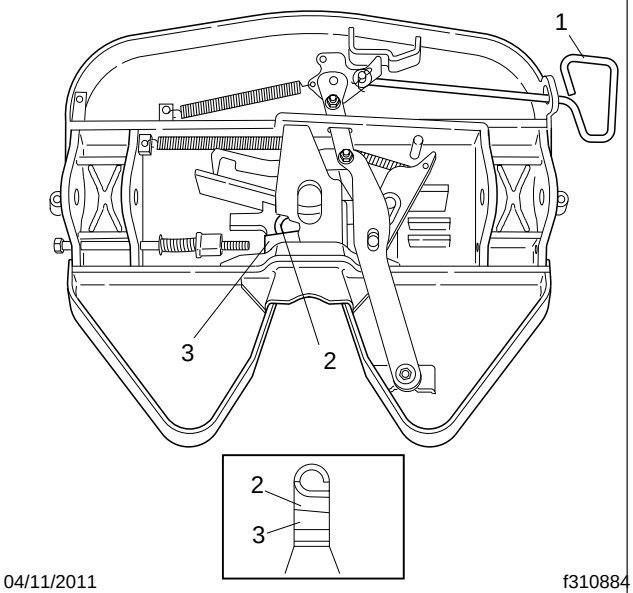
1. Tilt the top plate forward (the front of the fifth wheel is down) and apply grease to each bearing area through the zerk fittings located on each side of the top plate just to the front of the bracket pins. Continue to apply grease until it is coming out of the back of the bearing. It may be necessary to raise the rear of the fifth wheel with a pry bar to open up the pocket slightly and allow the grease to flow through. A substantial amount of grease may be required initially to fill the reservoir.

   Tilt the fifth wheel rearward (the rear of the fifth wheel is down) and repeat the greasing procedure. Rock the top plate back and forth several times to spread the grease over the bearing surface.
2. Inspect the trailer kingpin plate and top surface of the fifth wheel to make sure each is properly greased. A liberal coating of grease should be applied to the complete surfaces of both the trailer kingpin plate and the top surface of the fifth wheel.

NOTE: Do not use a lube plate (high density polyethylene) on top of the fifth wheel or on the kingpin instead of grease without prior approval by Fontaine Fifth Wheel. The additional thickness of this material can prevent the proper operation of the fifth wheel and may cause a dangerous condition.

3. Lubricate the fifth wheel prior to opening and closing. Grease the jaw and wedge with a screwdriver and distribute the grease along the full length of the jaw and wedge mating surfaces. See **Fig. 11**. Open and close the fifth wheel several times to further distribute the grease.

   Lightly oil other moving parts in the fifth wheel.



1. Pull Handle
2. Jaw
3. Wedge

Fig. 11, Fontaine Fifth Wheel

4. Apply grease to the top plate. Spread grease all over the mating surface of the top plate. Be sure the grease pockets built into the top plates are full of grease.

ConMet Simplex

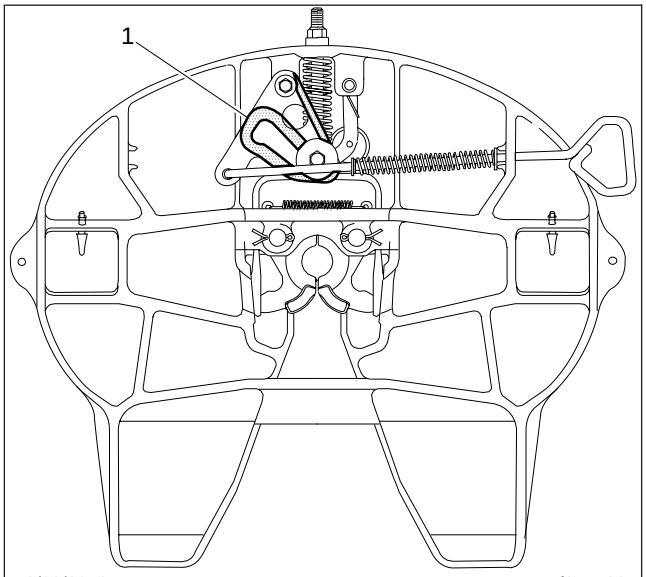
Apply a heavy coat of grease to the top plate, either through the grease fittings located on the underside of the top plate, or by direct application.

Apply grease directly to the lock mechanism.

If lubrication fittings are present, lubricate the interface of the steel bracket shoe and bracket trunnion.

Holland FW35

1. Using a water-resistant lithium-base grease, grease the top plate.
2. Using a light oil (such as SAE 10W or 20W motor oil), lubricate the cam track and pivot. See **Fig. 12**.
3. Grease the yoke tips, locks, and the release handle and spring; see **Fig. 13**. Grease the mounting bracket supports through the grease fittings. A “low temp” grade grease rated for -30°F (-34°C) or lower such as Cato Oil and Grease #5213, Craftsman Chemical Co. #LTF 2, Mystic LP-200, or equivalent is recommended.



Use a light oil (such as SAE 10W or 20W motor oil) to lubricate the cam track and pivot.

1. Cam Plate

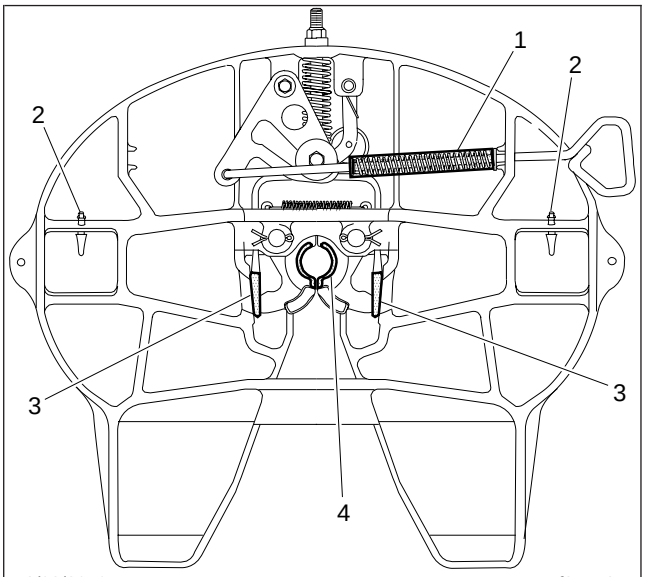
Fig. 12, Holland FW35 Fifth Wheel, Oil Lubrication

Jost

Lubricate the kingpin lock using a hand pump grease gun through the grease zerk on the skirt of the fifth wheel; see **Fig. 10**. Apply a light oil to all moving parts. For sliding fifth wheels spray diesel fuel on the slide path of the base plate.

NOTICE

Do not use a power grease gun. The pressure will damage the lube line.



1. Release Handle and Spring
2. Grease Fitting
3. Yoke Tip
4. Locks

Fig. 13, Holland FW35 Fifth Wheel, Grease Lubrication

If the fifth wheel is not equipped with low-lube plates, apply a lithium-based grease with extreme pressure (EP) additive to the trailer contact surface of the fifth wheel.

NOTE: If the fifth wheel is equipped with low-lube plates, the top plate only requires lubrication at the new product break-in stage. The low-lube plates require no further lubrication.

31–04 Trailer Electrical Connector Lubricating

In some cases, failure of trailer cables occurs due to intrusion of chloride-based road deicing chemicals into the trailer connector. Once inside the connector, the chloride-based chemicals corrode the brass terminals and create bridging between positive and ground terminals.

NOTE: The use of soap is not recommended for cleaning the electrical connector, as some soaps may increase the corrosion process.

1. Wash out any existing grease, dirt, and corrosion on the trailer connectors with electrical contact cleaner spray.
2. Grease the trailer connector with a lithium-based dielectric grease.

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Suspension Lubricating	32–02
Suspension U-Bolt Torque Checking	32–03

32–01 Suspension Inspecting

Freightliner Spring Front and Rear Suspension Spring Assemblies Inspection

Inspect the front and rear suspension spring assemblies for pitted, cracked, broken, or abnormally bent leaves, and extreme rust. If any of these conditions exist, replace the spring assembly. See **Group 32** of the *Business Class® M2 Workshop Manual* for instructions.

⚠ WARNING

Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. On front spring assemblies, if cracks or breaks exist in the two top leaves, a loss of vehicle control could occur. Failure to replace a damaged spring assembly could cause an accident resulting in property damage, serious personal injury, or death.

IMPORTANT: On multi-leaf suspensions, closely inspect each component of the leaf spring assemblies, including the brackets, U-bolts, and related parts.

Freightliner Spring Rear Suspension Spring Brackets and Equalizer Brackets (Tandems) Inspection

Inspect the forward and rear spring brackets, equalizer brackets (tandems), and the wear pads, for wear, cracks, and other damage. If any of these conditions exist, replace the damaged bracket(s) and wear pad(s). See **Group 32** of the *Business Class® M2 Workshop Manual* for instructions.

⚠ WARNING

Failure to replace the forward spring brackets, equalizer brackets, or rear spring brackets if they are worn, cracked, or otherwise damaged could result in progressive damage to and eventual breakage of the bracket. This could cause a loss of vehicle control resulting in property damage, serious personal injury or death.

Freightliner Spring Tandem Axle Suspension Crossmember and Gussets Inspection

Inspect the tandem-axle frame crossmember and gussets for wear, cracks, and other damage. If any of these conditions exist, replace the damaged parts. See *Section 31.00, Subject 130,* of the *Business Class® M2 Workshop Manual* for instructions. Check all fasteners for tightness. See **Group 00** of this manual for torque values.

⚠ CAUTION

Failure to replace the suspension crossmember or gussets if they are cracked, worn, or otherwise damaged could result in damage to the vehicle chassis.

Freightliner Spring Shock Absorber Check

NOTE: Shock absorbers are optional on spring suspensions.

Make sure that the shock absorber brackets are tight and that the shock absorber is not striking or rubbing on the frame or some other part of the chassis. Check the rubber mounting bushings and replace if worn. Inspect the shock absorber for oil leakage, which is defined as being drips of oil on the sides of the shock absorber.

If the shock absorber is worn or damaged, replace it with a new one.

Freightliner 23K, 26K, 30K Spring Single and Tandem Radius Rod Bushing Check

1. Without detaching the torque arms, use your hand to attempt to move each of the radius rod ends up, down, in, and out. If there is any movement, replace the torque arm.

2. Inspect the weld seams between the torque arm tube and the shorter bushing tubes. If there are cracks, replace the torque arm. Do not weld the torque arm for any reason.
3. Inspect the rubber bushing ends. See **Fig. 1**. Replace the torque arm for any of the following reasons:
   - There are gaps between the rubber bushing and the pin or the outer steel sleeve.
   - Either bushing end contacts a torque arm pin mounting bolt.
   - There are cracks in the bushing.
   - Part of the rubber bushing extends beyond the outside diameter of the outer bushing sleeve.

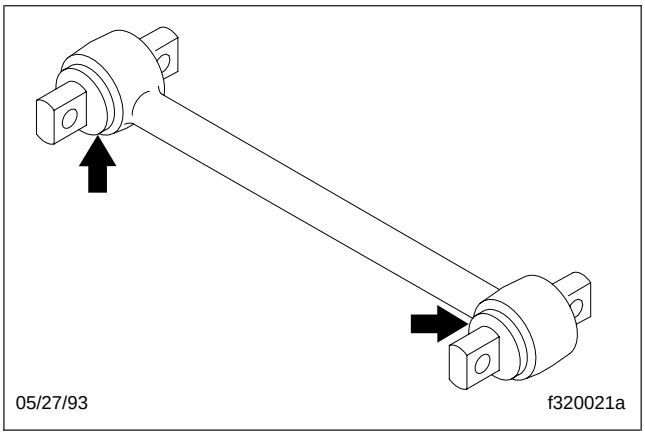
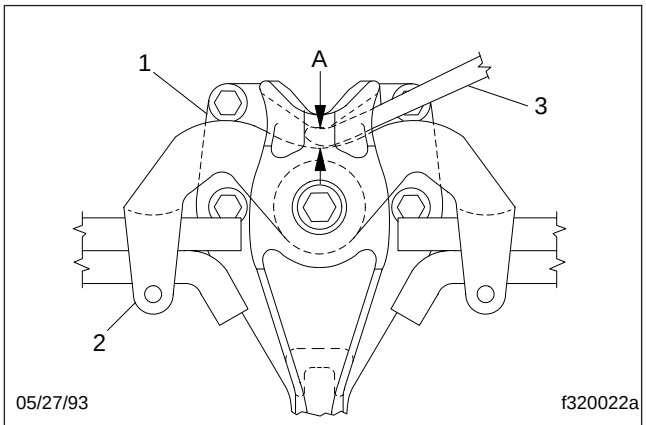


Fig. 1, Torque Arm Bushings

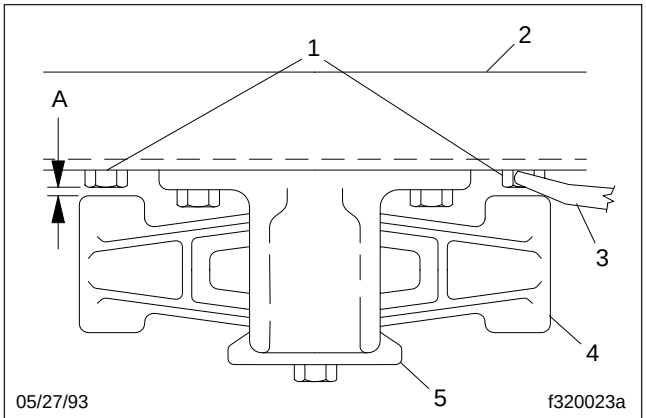
Freightliner Spring Tandem Suspension Equalizer Bushing Check

1. Block the frame up enough to take the weight of the chassis off of the springs. Attempt to move the equalizer up and down, by using a pry bar between the top of the equalizer and the top of the equalizer bracket. Apply hand-pressure only. See **Fig. 2**. If movement at the center of the equalizer exceeds 1/8 inch (3 mm), replace the equalizer bushings.
2. With the vehicle unloaded, attempt to move the equalizer side to side using a pry bar between the equalizer and frame rail. Apply hand-pressure only. See **Fig. 3**. If clearance between the equalizer assembly and any frame component or fastener is less than 1/8 inch (3 mm), replace the equalizer bushings.



A. Measure the change in gap at this point.
1. Equalizer Bracket
2. Equalizer
3. Pry Bar

Fig. 2, Side View of the Equalizer



A. 1/8 inch (3 mm) Clearance
1. Frame Fasteners
2. Frame Rail
3. Pry Bar
4. Equalizer
5. Equalizer Bracket

Fig. 3, Top View of the Equalizer

52-Inch Multi-leaf Spring Component Check

No lubrication is required on the 52-inch multi-leaf spring rear suspension.

Inspect the stabilizer bar, if present, for irregular bushing wear or cracks in the brackets. Check the rubber helper spring, if present, for cracks.

60-Inch Tapered Leaf Spring Component Check

No lubrication is required on the 60-inch tapered leaf spring rear suspension.

Inspect the rear shackle brackets for bushing wear or cracks.

Inspect the stabilizer bar, if present, for irregular bushing wear or cracks in the brackets. Check the rubber helper spring, if present, for cracks.

Freightliner AirLiner Component Clearance Check

Check that the air line support brackets are positioned so the air lines do not rub against anything. Reposition any configurations that could contact and result in friction and wear. There must be at least 1 inch (25 mm) clearance around the rubber air spring when inflated. If the clearance is less than 1 inch (25 mm), relocate the obstructing parts.

⚠ CAUTION

Failure to relocate obstructing parts could result in damage to the air spring.

Freightliner AirLiner Component Inspection and Operation Check

⚠ WARNING

Inspect the components and check their operation as described below. Failure to perform these inspections and checks could result in separation of worn suspension components and loss of vehicle control, possibly causing personal injury or death, or property damage.

1. Chock the front tires. Raise the rear of the vehicle so the tires just clear the ground and the suspension is fully extended. Place safety stands under the vehicle frame.
2. Squeeze all air springs to check for complete deflation.
3. Inspect the air spring piston for cracks, chips, and broken areas. Check the air bag for rips, tears, and holes. Verify that the air spring assembly does not leak.
4. Check the axle connection welds (beam seat to equalizing beam) and axle adapter to axle for cracks. If welds are cracked, grind them out and reweld the parts.
5. Move the axle up and down while checking for signs of looseness due to worn parts at the front pivot connections. Replace any worn parts.
6. Inspect the shock absorbers for oil leaks and worn rubber bushings. Replace the shock absorbers and/or rubber bushings if wear or damage is noted.
7. Inspect the stabilizer bar, if so equipped, for irregular bushing wear or cracks in the brackets. The stabilizer bar is optional on 10,000- and 15,000-pound AirLiner suspension systems.
8. Remove the safety stands and lower the rear of the vehicle to the ground. Run the engine until air pressure of at least 100 psi (689 kPa) is maintained throughout the system.
9. Check that all air springs are inflated.

Freightliner AirLiner Control Rod Check

1. Without disconnecting the control rods, use your hand to attempt to move each of the control rod ends up, down, in, and out. If there is any movement, examine the control rods for wear or damage. Replace if necessary.
2. Inspect the rubber bushings for cracks or cuts.
3. Check for any shifting of the barpin.
4. Check for cracks in the metal components and welds.

NOTE: The Freightliner AirLiner Suspension is manufactured at numerous weight ratings up to 46,000 pounds. The control rod on the 46,000-pound-rated suspension is larger, and is fastened differently than on other applications.

Freightliner TufTrac

1. Inspect the suspension spring assemblies for pitted, cracked, broken, or abnormally bent

leaves, and extreme rust. If any of these conditions exist, replace the spring assembly.

⚠ WARNING

Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. On front spring assemblies, if cracks or breaks exist in the two top leaves, a loss of vehicle control could occur. Failure to replace a damaged spring assembly could cause an accident resulting in property damage, serious personal injury, or death.

IMPORTANT: On multi-leaf suspensions, closely inspect each component of the leaf spring assemblies, including the brackets, U-bolts, and related parts.

2. Inspect the brackets for cracks in the castings. Inspect the V-rod tower welds for cracking or other signs of damage. Also check for contact between the frame rail and the upper axle clamp brackets. If contact exists, check the V-rod bushing for wear. Check the V-rod fastener torques.
3. Inspect the rubber center bearing and spring tip pads for excessive wear, including de-lamination of the rubber-to-metal shim interface, and distortion and degradation of rubber.
4. Inspect the V-rods and lower control rods for wear and looseness.
   - 4.1 Without disconnecting the control rods, use your hand to attempt to move each of the control rod ends up, down, in, and out. If there is any movement, examine the control rods for wear or damage. Replace if necessary.
   - 4.2 Inspect the rubber bushings for cracks or cuts.
   - 4.3 Check for any shifting of the barpin.
   - 4.4 Check for cracks in the metal components and welds.
5. Check all fasteners for looseness.
6. Inspect the shock absorbers for oil leaks and worn rubber bushings. Replace the shock absorbers and/or rubber bushings if wear or damage is noted.

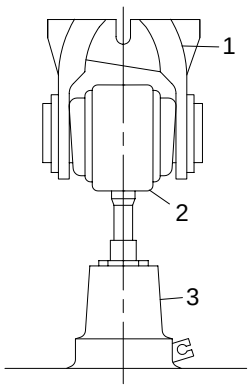
Hendrickson Suspension Inspection

Inspect the suspension assembly for wear, cracks, and damage to its components. Replace the component(s) if any wear, cracks, or damage exists. Check all fasteners for tightness.

Check for distorted or frayed rubber at the beam end bushings. If the bushings are damaged, replace them.

Check that the ends of the equalizer beam are not lower in the beam hanger.

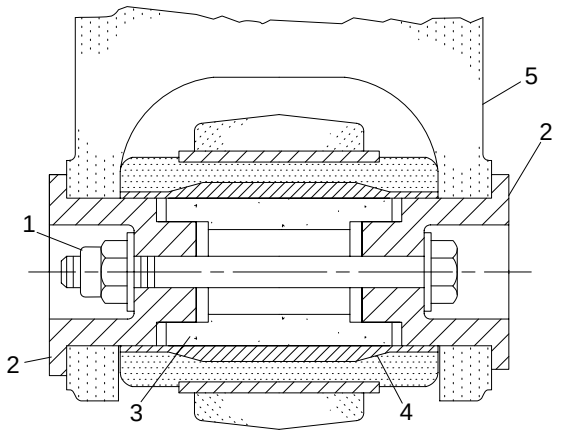
If the equalizer beam ends appear lower, use a jack to raise each beam end, then check for movement of the inner metal of the rubber end bushing. See **Fig. 4**. Movement cannot be corrected by tightening the fastener, because parts could be damaged. If there is movement, replace the rubber end bushings and all connecting parts.



1. Beam Hanger
2. Equalizer Beam
3. Jack

Fig. 4, Raising the Beam End

After repairs to the suspension, check the fastener torque after the vehicle has been in service for 2500 miles (4000 km). Tighten the adapter-type beam end connection nut 210 to 240 lbf·ft (285 to 325 N·m). See **Fig. 5**. Do not overtorque.



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NOTE: Do not use the three-piece adapter without the intermediate tube.

1. Nut
2. Adapter
3. Intermediate Tube
4. Inner Metal of Beam End Bushing
5. Beam Hanger

Fig. 5, Three-Piece Adapter-Type Beam End Connection

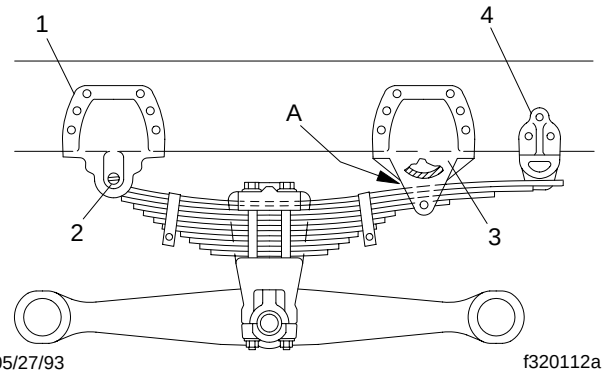
⚠ WARNING

Insufficient beam end fastener torque could cause the beam to separate from the axle. This will cause loss of vehicle control resulting in property damage, serious personal injury or death.

Hendrickson Leaf Spring Assembly Inspection

1. Inspect the spring hangers for wear of the spring pin holes, cams, and the spring hanger legs. See **Fig. 6**.
2. If equipped with the RTE series, the gap between the rear (no. 2) spring hanger and the top spring leaf should measure at least 3/8 inch (9.5 mm) in an unloaded condition.

   If the measurement is less than 3/8 inch (9.5 mm), install new rear (no. 3) extension hangers. Lubricate the bolt threads with SAE 20 oil. Tighten the 1/2–13 locknuts with hardened washers 85 lbf·ft (115 N·m).
3. Inspect the spring leaves for cracks, gouges, wear, or abnormal bends. The main (no. 1) and wrapper spring leaves (no. 2)—the top two spring leaves—may be individually replaced. If equipped with the RTE series suspension, the first, second, and third spring leaves (the top three spring leaves) may be individually replaced. If a spring leaf is damaged below these numbers in a pack, replace the spring assembly. In addition, replace both spring assemblies to ensure even spring deflection.



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A. Minimum gap of 3/8 inch (9.5 mm).
1. Forward (no. 1) Spring Hanger
2. Spring Eye Pin
3. Rear (no. 2) Spring Hanger
4. Rear (no. 3) Extension

Fig. 6, Unloaded RTE Spring Suspension

Hendrickson Radius Rod Bushing Check

1. Without detaching the torque arms, use your hand to attempt to move each of the radius-rod ends up, down, in, and out. If there is any movement, replace the torque arm.
2. Inspect the rubber bushing ends. Replace the torque arm if there are gaps between the rubber bushing and the pin or the outer steel sleeve, if either bushing end contacts a torque arm pin mounting bolt, if there are cracks in the bushing, or if part of the rubber bushing extends beyond the outside diameter of the outer bushing sleeve.

Chalmers Suspension Inspection

Chock the front wheels to prevent the vehicle from moving. Place the transmission in neutral and release the spring or driveline brakes before inspecting the rear suspension.

Power wash the Chalmers rear suspension or clean it with a hard-bristle brush before performing a visual inspection.

1. Visually inspect the rubber bushings for cracks or other damage.

   Try to move the torque rod ends, using your hands only, and check for any free-play. If free-play is felt, replace the torque rod end bushing. Do not use a pry bar to check for free-play. Use of a pry bar may lead to premature bushing replacement.

2. If equipped with optional shock absorbers, check for worn, broken, or damaged shock bushings, heavy corrosion on the shock absorber body, or fluid leaking from the shock absorber. Replace the shock absorbers if any of these conditions are found.

3. Lift the rear of the vehicle and support the frame on jack stands to unload the suspension components. The vehicle is lifted high enough when the beam ends are off of the saddles. All jack stands must be of sufficient strength and rigidity to safely support the vehicle. Do not perform any work on or around a vehicle that is supported solely by a lifting device.

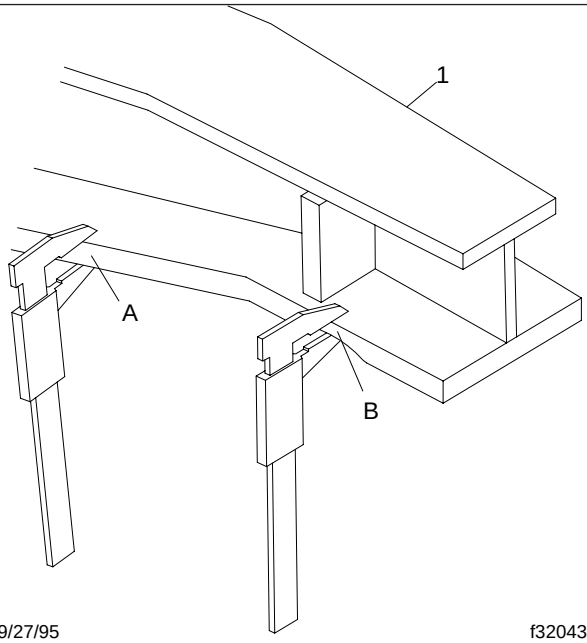
   Visually inspect the walking beam for cracks, or other damage. If damage is found, replace the walking beam.

   Keep the vehicle supported by the jack stands for the next operation.

4. Manipulate the walking beam so that a micrometer, vernier, or dial caliper can be used to determine the wear area thickness on the bottom face. See **Fig. 7**. Measurements should be taken a minimum of 1/2 inch (13 mm) from the beam flange edges to eliminate any edge wear that may have occurred. Subtract the wear area thickness from the nonwear area to determine the amount of wear.

   If the beams show any wear greater than the allowable 0.062-inch (1.5-mm) wear, a Chalmers wear plate must be installed, or the walking beam must be replaced.

5. Rotate the restrictor cans 360 degrees and visually inspect the cans for cracks, severe corrosion, and distortion. If any of these conditions are present or the restrictor can is missing, replace the restrictor can.



A. Non-wear Area
B. Wear Area
1. Walking Beam

Fig. 7, Walking Beam End Wear Thickness

WARNING

Replace all cracked or missing restrictor cans. Failure to do so could lead to loss of vehicle control, which could result in property damage, serious personal injury, or death.

6. Remove the jack stands, then lower the vehicle. Check that the spring or driveline brake is applied, then remove the wheel chocks.

32–02 Suspension Lubricating

Freightliner Spring Front Suspension

Wipe all dirt from the grease fittings at the forward spring pin and the spring shackle pins. Then apply multipurpose chassis grease with a pressure gun until the old grease is forced out.

Freightliner Spring Rear Suspension

Single Axle

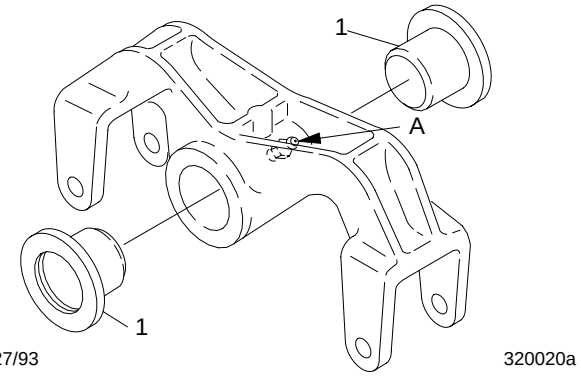
Lubrication is not required on single-axle spring rear suspensions.

Tandem Axle

CAUTION

If the equalizer cap and tube assembly is equipped with a nonrelief grease fitting, excessive lubrication can damage the bushings.

Lubricate the equalizer cap and tube assembly bushings by applying multipurpose chassis grease at the pressure relief grease fitting. See **Fig. 8**. Lubricate with a hand gun or pressure gun until grease is forced out from the base of the pressure-relief fitting.



A. Lubricate here.
1. Cap and Tube Assembly Bushing

Fig. 8, Equalizer Assembly Lubrication

Hendrickson Equalizer Beam End Bushings and Rubber Center Bushings

No lubrication is required for the equalizer beam end bushings or equalizer beam rubber center bushings.

Hendrickson Spring Eye Pins, RT and RTE Series

Apply multipurpose chassis grease at the spring eye pin grease fitting, located on the inboard side of the spring eye pin, until clean grease appears at both ends of the spring eye pin. See **Fig. 6**.

Freightliner TufTrac

The TufTrac suspension is maintenance-free and designed so that lubrication is not required. There are no provisions for lubrication, and attempting to lubricate the suspension could shorten component life.

32–03 Suspension U-Bolt Torque Checking

Check the U-bolt torque of both the front and rear axles where applicable.

CAUTION

Failure to retorque the U-bolt nuts could result in spring breakage and abnormal tire wear.

1. Park the vehicle on a flat surface and apply the parking brakes. Chock the tires to prevent the vehicle from moving.
2. Check the U-bolt torque in a diagonal pattern. Set a click-type torque wrench to the highest torque value for the fastener being checked. See **Table 1** for U-bolt torque specifications. Turn the wrench in a clockwise motion (looking up) until the torque wrench clicks.

Spring Assembly U-Bolt High Nut Torque Values*	
Size	**Torque: lbf·ft (N·m)**
5/8–18	Stage 1: Hand-tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 180 to 230 (245 to 313)
3/4–16	Stage 1: Hand-tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 270 to 330 (367 to 449)

Spring Assembly U-Bolt High Nut Torque Values*	
Size	**Torque: lbf·ft (N·m)**
7/8–14	Stage 1: Hand-tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 420 to 500 (571 to 680)
1–14	Stage 1: Hand-tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 520 to 600 (707 to 816)

* Tighten in a diagonal pattern as shown in **Fig. 9**.

Table 1, Spring Assembly U-Bolt High Nut Torque Values

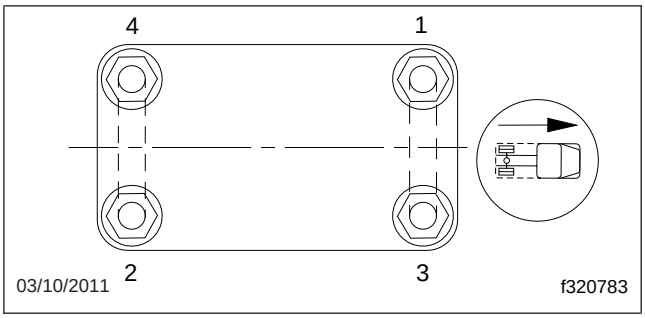


Fig. 9, Tightening Pattern for U-Bolt High Nuts

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33–01 Kingpin Lubricating

Sealed and Easy Steer™ Kingpins—Axles With Unitized Wheel Ends

NOTE: This procedure applies to 921, 931, 932, 933, 934, 941, 942, 943, 951, 961, 963, 966, 967, 971, and 975 Series Easy Steer sealed front axles. Refer to the identification tag on the front of the axle beam.

On sealed and Easy Steer Plus™ front axles, the grease fittings are on the top and bottom kingpin caps of the knuckle.

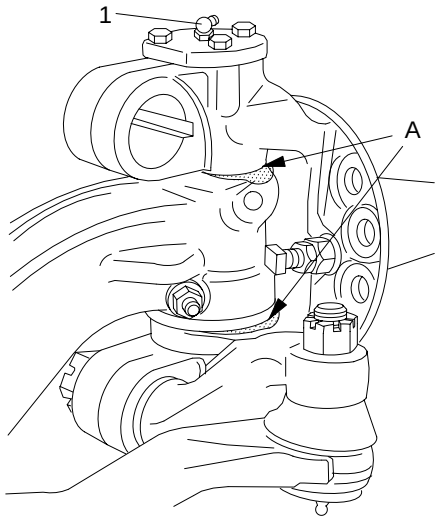
1. Shut off the engine, apply the brakes, and chock the rear tires.
2. Make sure the tires touch the ground. **Do not** raise the vehicle.
3. Clean off all grease fittings prior to lubrication.

IMPORTANT: Meritor recognizes that industry trends are moving toward increased selection and usage of synthetic grease in vehicle maintenance. However, some seals are known to expand when in contact with synthetic grease. Consult your local Meritor representative for synthetic grease application references **before** using any synthetic grease when performing axle service and maintenance.

4. Using a multipurpose grease, NLGI grade 1 or 2, lubricate the kingpins through the grease fittings on the top and bottom of the knuckle. See **Fig. 1**.
5. Apply lubricant until new lubricant comes from the thrust bearing seal and the upper shim pack.
6. Remove the chocks from the tires.

Easy Steer™ Kingpins—Axles With Unitized Wheel Ends

NOTE: This procedure applies to Easy Steer Plus™ MFS 10-2015-N and MFS 12-2015-N sealed front axles. Refer to the identification tag on the front of the axle beam.



A. Apply lubricant until new lubricant comes from these areas.
1. Grease Fitting

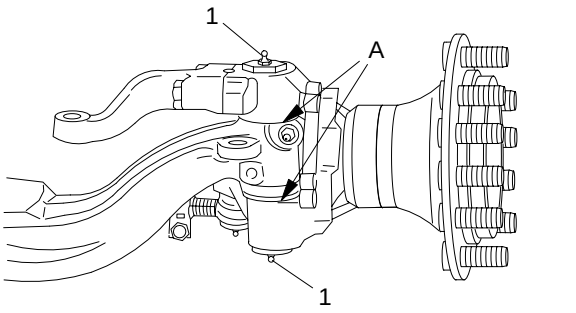
Fig. 1, Sealed, Easy Steer Kingpin Lubrication

On Easy Steer Plus front axles, the grease fittings are on the top and bottom kingpin caps of the knuckle.

1. Shut off the engine, apply the brakes, and chock the rear tires.
2. Make sure the tires touch the ground. **Do not** raise the vehicle.
3. Clean off all grease fittings prior to lubrication.

IMPORTANT: Meritor recognizes that industry trends are moving toward increased selection and usage of synthetic grease in vehicle maintenance. However, some seals are known to expand when in contact with synthetic grease. Consult your local Meritor representative for synthetic grease application references **before** using any synthetic grease when performing axle service and maintenance.

4. Using a multipurpose grease, NLGI grade 1 or 2, lubricate the kingpins through the grease fittings on the top and bottom of the knuckle. See **Fig. 2**.
5. Force lubricant into the upper and lower kingpin grease fitting caps until new lubricant flows from between the upper axle beam end and the



A. Apply lubricant until new lubricant comes from these areas.
1. Grease Fitting

Fig. 2, Sealed, Easy Steer Plus Kingpin Lubrication

knuckle, and between the lower axle beam end and the knuckle. See **Fig. 2**.

6. Remove the chocks from the tires.

33–02 Tie Rod End Lubricating

This procedure applies to all tie rod ends on Meritor nondrive steering axles.

1. Park the vehicle with the wheels in the straight-ahead position. Turn off the engine, apply the brakes, and chock the rear tires.
2. Wipe clean the zerk fitting and the seal or boot.

NOTE: Synthetic lubricants are not approved for tie rod end lubrication.

3. Using a grease gun, apply a multipurpose grease, NLGI grade 1 or 2, to the zerk fitting until all the old grease is purged from the boot. Discolored old grease should come out of the purge holes near the boot crimp or bellows area.

   Apply grease until all the old grease is purged from the boot.

NOTE: If using an air pressure grease gun, do not exceed 150 psi (1035 kPa).

4. If the tie rod end is designed for lube service and it does not accept grease, perform the following substeps.

   4.1 Remove the zerk fitting.

   4.2 Inspect the threaded zerk fitting hole in the tie rod end, and remove any obstructions.

   4.3 Install a new zerk fitting.

   4.4 Apply lubrication to the new zerk fitting.

5. Remove the chocks from the tires.

33–03 Draw Key Nut Torque Checking

Axles With Unitized Wheel Ends

Check the torque of the nut that holds the draw key on the side of the knuckle. The torque should be 30 to 45 lbf·ft (41 to 61 N·m). See **Fig. 3**.

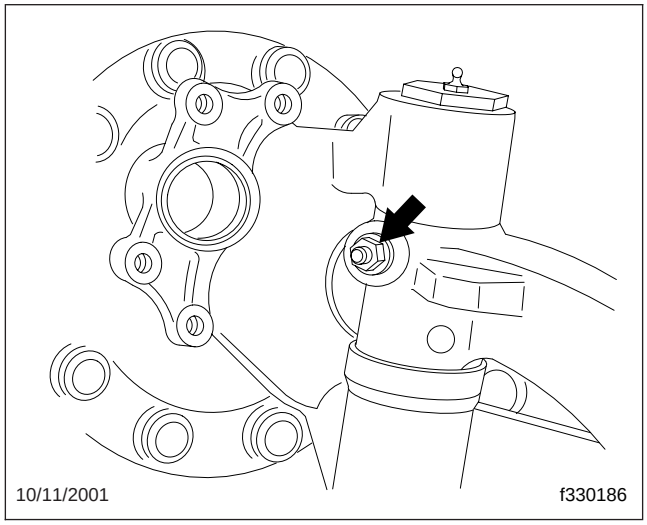


Fig. 3, Draw Key Nut

33–04 Tie Rod End Inspecting

IMPORTANT: If the tie rod end boot is torn or missing, replace the entire tie rod end. Do not replace the boot only.

1. Shut off the engine, apply the brakes, and chock the rear tires.
2. Check the tie rod boot for cracks, tears, or other damage. If the tie rod boot is damaged, replace the entire tie rod end.
3. Grasp by hand (or use a pipe wrench with jaw protectors to avoid gouging the cross tube) and

slightly rotate the cross tube toward the front of the vehicle and then slightly toward the rear. Then center the cross tube between the stop positions. If the cross tube does not rotate in either direction, replace both tie rod ends.

4. Position yourself directly below the ball stud socket. Using both hands, grab the end as close to the socket as possible, no more than 6 inches (15.2 cm) from the end. Firmly apply about 100 pounds of hand pressure in an up and down motion several times. When moving the assembly, check for any movement at both tie rod ends. See **Fig. 4**.

   If any movement is detected at one tie rod end, replace **both** tie rod ends. Always replace tie rod ends in pairs, even if only one tie rod end is damaged.

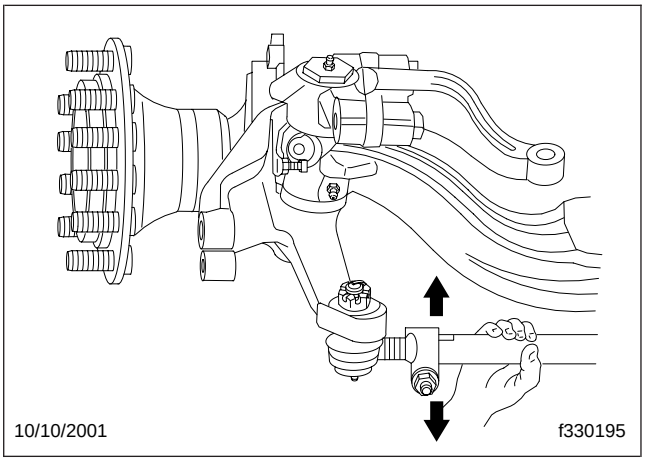


Fig. 4, Check Movement of Tie Rod End

CAUTION

Do not attempt to straighten a bent cross tube. Doing so could result in damage to the axle. Be sure to replace the cross tube with an original equipment cross tube with the same length, diameter, and thread size as the existing cross tube.

5. Check the cross tube for cracks or other damage. If the cross tube is bent or damaged, replace the cross tube.
6. Check the clamps for damage. If a clamp is damaged, replace the clamp. Replace the entire cross tube assembly if either clamp is welded to the cross tube.
7. Check for proper installation of the tie rod end clamp to the cross tube. Make sure that the tie rod ends are threaded in the cross tube past the clamps and the slots at the cross tube ends.
8. Check the zerk fittings for damage. If a zerk fitting is damaged, replace it.

   Some tie rod ends have no zerk fittings because they are not greaseable. Do not install a zerk fitting on a nongreaseable tie rod end.
9. Check that the cotter pin is in place. If it is not, tighten the tie rod end nut to one of the following specs depending on the size of the stud.
   - 7/8–14, 160 to 300 lbf·ft (217 to 406 N·m)
   - 1–14, 250 to 450 lbf·ft (339 to 610 N·m)
   - 1-1/8–12, 350 to 650 lbf·ft (475 to 881 N·m)
   - 1-1/4–12, 500 to 675 lbf·ft (678 to 915 N·m)
10. Check the steering arm bolts for a minimum torque of 300 lbf·ft (406 N·m). If the steering arm bolt torque has fallen below this specification, remove the bolt, clean all the threads, and apply new Loctite® 680. Tighten the bolt 300 to 450 lbf·ft (406 to 610 N·m).
11. Remove the chocks from the tires.

33–05 Wheel End Inspection and Maintenance, 6,000-Pound and 8,000-Pound Steer Axles with Oil-Lubricated Hubs

Periodic inspection and maintenance of wheel ends on 6,000-pound and 8,000-pound steer axles is essential to sound wheel bearing performance. Check for leaks at the oil seal and hub, and inspect the lubricant per the maintenance intervals provided in **Group 00** of this manual.

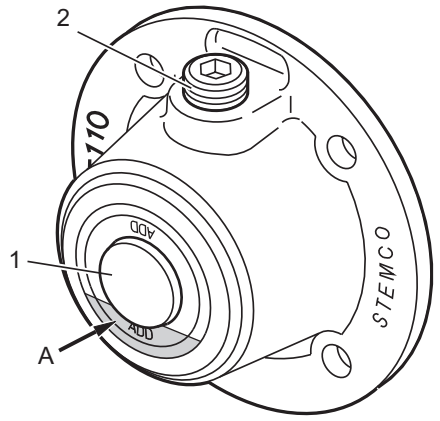
Oil Seal Leak Check

Check for evidence of oil leakage at the oil seal. If a leak is found, replace the seal. See **Section 33.02** of the *Business Class® M2 Workshop Manual* for instructions.

Hub Cap Leak Inspection

Check for evidence of oil leakage between the hub cap, gasket and hub surface. If leakage is evident, replace the gasket with a new one. See **Section 33.01, Subject 100** of the *Business Class® M2 Workshop Manual* for instructions.

Check for a missing hub cap fill plug or vent plug. See **Fig. 5**. Replace any missing parts. If a vent plug is missing, the oil quality is compromised and must be replaced. See **Section 33.01, Subject 100** of the *Business Class® M2 Workshop Manual* for instructions.



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A. Hub Cavity Full
1. Vent Plug
2. Magnetic Drain/Fill Plug

Fig. 5, Stemco Hub Cap

Lubricant Inspection

Rotate the hub so that the fill plug is down, and drain a small sample of hub oil into a plastic container that is free of debris, especially any metallic particles. Then use a magnet to probe the sample. Note whether there is substantial metallic debris present, and compare the oil color to new approved oil. Acceptable oil will have a color similar to new oil and have no water or metal contaminants.

If the oil is not acceptable, inspect the bearings for damage. Replace the bearings as needed, and install the hub per **Section 33.01, Subject 100** of the *Business Class® M2 Workshop Manual*.

If the oil is acceptable, check the oil level. If it is not full (see **Fig. 5**), fill it to the bottom of the vent plug hole with approved lubricant (see **Table 1**).

Lubricant Specifications, Over-the-Road Service Applications	
Lubricant Type	**Lubricant SAE Viscosity Grade**
Synthetic Drive Axle Lubricants or Equivalent with SAE Specification J2360 or Military Specification MIL-L-2105E	75W-90

Table 1, Lubricant Specifications, Over-the-Road Service Applications

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Axle Breather Checking	35–02
Axle Lubricant Changing and Magnetic Plug Cleaning	35–03
Axle Lubricant Level Checking	35–01

35–01 Axle Lubricant Level Checking

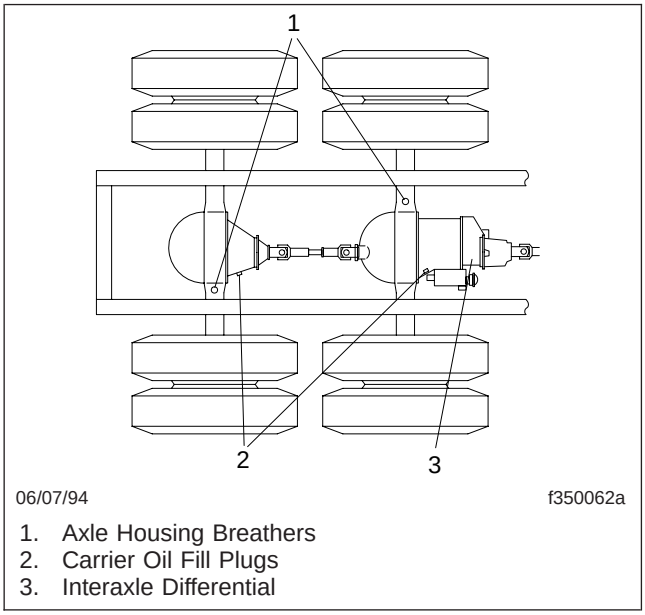
CAUTION

Failure to keep the rear axle filled to the proper level with the recommended lubricant can result in rear axle damage.

1. Clean the oil fill hole plug located in the carrier or the side of the axle housing and the area surrounding it. See **Fig. 1**. Remove the plug.

NOTE: Some Meritor axles have a small tapped and plugged hole located below the housing oil fill hole. This smaller hole is for the lubricant temperature sensor only and must not be used as a fill or level hole.

2. When the vehicle is on level ground, the lubricant must be level with the bottom of the oil fill hole. If low, add lubricant. See **Table 1** for approved axle lubricants and see **Table 2** or **Table 3** for axle capacities.



1. Axle Housing Breathers
2. Carrier Oil Fill Plugs
3. Interaxle Differential

Fig. 1, Fill Hole Plug and Axle Housing Breather Locations

35–02 Axle Breather Checking

The axle housing breather must remain clean. See **Fig. 1**. When the axle lubricant level is checked, check that the axle breather is open. Check more often under poor operating conditions. If the breather is plugged, clean it or replace it as needed.

Meritor Drive Axle Recommended Lubricant			
Lubricant Type	**Ambient Temperature**	**Viscosity Grade**	**Meritor Specification**
Hypoid Gear Oil API Service Classification GL–5	10°F (–12.2°C) and up*	85W–140	0–76–A
	–15°F (–26.1°C) and up*	80W–90	0–76–D
	–40°F (–40°C) and up*	75W–90	0–76–E
	–40°F (–40°C) to 35°F (2°C)	75W	0–76–J
	–40°F (–40°C) and up*	75W–140	0–76–L
Synthetic Gear Oil	–40°F (–40°C) and up*	75W–90	0–76–N
	–40°F (–40°C) and up*	75W–140	0–76–M

* There is no upper limit on the ambient temperature, but axle sump temperature must never exceed 250° (121°C).

Table 1, Meritor Drive Axle Recommended Lubricant

Meritor Drive Axle Lubricant Capacities for Single Axles	
Axle Model	**Capacity*: pt (L)**
MS–10–113D	14 (6.6)
MS–12–113D	15 (7.1)
RS–13–120	18.4 (8.7)
RS–15–120	14.3 (6.8)
RS–17–145	33.6 (15.9)
RS–17–144	32.3 (15.3)
RS–19–144	32.3 (15.3)
RS–19–145	33.2 (15.7)
RS–21–145	32.3 (15.3)
RS–21–160	39.5 (18.7)
RS–21–230	38.9 (18.4)
RS–23–160	39.5 (18.7)
RS–23–161	39.5 (18.7)
RS–23–186	47.3 (22.4)
RS–23–240	37.4 (17.7)
RS–26–185	38.0 (18.0)
RS–30–185	38.0 (18.0)

* Quantities listed are approximate and include 1 pint (0.5 liter) for each wheel end and with the drive pinion at 3 degrees.

Table 2, Meritor Drive Axle Lubricant Capacities for Single Axles

Meritor Drive Axle Lubricant Capacities for Tandem Axles		
Axle Model	**Axle Position**	**Capacity***
RT–40–145	Forward	30.2 (14.3)
	Rear	25.8 (12.2)
RT–40–145P	Forward	30.2 (14.3)
	Rear	25.8 (12.2)
RT–40–160	Forward	39.1 (18.5)
	Rear	34.4 (16.3)
RT–44–145 RT–44–145P	Forward	29.3 (13.9)
	Rear	25.1 (11.9)

Meritor Drive Axle Lubricant Capacities for Tandem Axles		
Axle Model	**Axle Position**	**Capacity***
RT–46–160	Forward	39.1 (18.5)
	Rear	34.4 (16.3)

* Quantities listed are approximate and include 1 pint (0.5 liter) for each wheel end and with the drive pinion at 3 degrees.

Table 3, Meritor Drive Axle Lubricant Capacities for Tandem Axles

35–03 Axle Lubricant Changing and Magnetic Plug Cleaning

A regular schedule for changing the axle lubricant in a particular vehicle and operation can be accurately determined by analyzing oil samples taken from the axle at specified intervals or mileages. Lubricant suppliers frequently make their laboratory facilities available for determining the useful life of their product under actual service conditions. The final schedule that is recommended may, for economic reasons, be related to lubricant changes that are governed by climatic conditions and magnetic plug maintenance. Change lubricant type and viscosity as climatic temperatures demand, regardless of vehicle mileage or established change schedule.

The normal operating temperature of compounded lubricants during the summer season is about 160 to 220°F (71 to 104°C). The chemicals and additives that give these lubricants increased load carrying capacity oxidize faster at temperatures above 220°F (104°C), contributing to more rapid lubricant deterioration. For this reason lubricants of this type that operate continuously at high temperatures must be changed more frequently.

⚠ CAUTION

Failure to change the axle lubricant at more frequent intervals, when adverse operating conditions require, could result in axle damage.

Axle Draining

1. Remove the plug at the bottom of the housing and drain the lubricant while the unit is warm. Allow enough time for all the old lubricant to drain completely.

2. Clean the drain plugs. For magnetic drain plugs, a piece of key stock or any other convenient steel slug may be used to short the two magnetic poles and divert the magnetic field.

NOTE: Meritor recommends using magnetic plugs with elements having a minimum pickup capacity of two pounds (one kilogram) of low-carbon steel in plate or bar form. Magnets will rapidly lose effectiveness as collected material bridges the gap between the two poles. Clean or change the plugs before this occurs. It may be necessary to clean or change the plugs one or more times between lubrication change intervals.

3. After cleaning the drain plugs, install and tighten the plugs 35 lbf·ft (47 N·m).

Axle Filling

1. With the vehicle on a level surface, fill the axle housings to the bottom of the oil fill hole (in the carrier or housing) with lubricant. See **Table 1** for approved axle lubricants and see **Table 2** or **Table 3** for axle capacities.

NOTE: Some Meritor axles have a small tapped and plugged hole located below the housing oil fill hole. This smaller hole is for the lubricant temperature sensor only and must not be used as a fill or level hole.

2. Install the fill hole plug and tighten it 35 lbf·ft (47 N·m).
3. After filling the carrier and housing assembly with lubricant, drive the vehicle unloaded for one or two miles (two or three kilometers) at speeds not to exceed 25 mph (40 km/h) to thoroughly circulate the lubricant throughout the assembly.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Wheel Nut Checking	40–01

40–01 Wheel Nut Checking

IMPORTANT: In addition to the maintenance interval in this manual, check the wheel nut torque the first 50 to 100 miles (80 to 160 km) of operation after a wheel has been removed and installed.

When checking wheel nuts on a stud-piloted dual disc assembly, remove one outer nut at a time, tighten the inner nut, then reinstall the outer nut. Repeat this procedure for all of the inner wheel nuts in the sequence shown in **Fig. 1**, then tighten all of the outer wheel nuts in the same sequence.

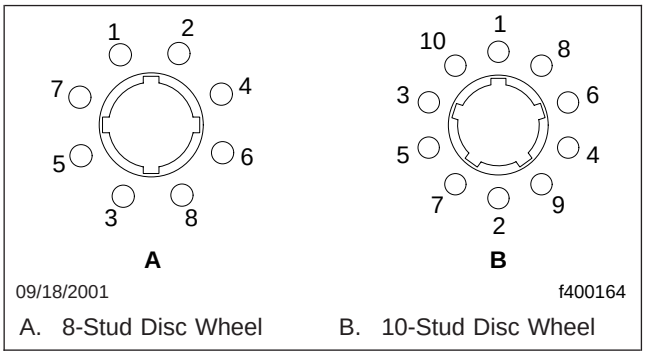


Fig. 1, Wheel Nut Tightening Sequence

⚠ CAUTION

Too little wheel nut torque can cause wheel shimmy, resulting in wheel damage, stud breakage, and extreme tire tread wear. Too much wheel nut torque can break studs, damage threads, and crack discs in the stud hole area.

See **Table 1** for wheel nut torque specifications and see **Fig. 1** for the tightening sequence.

Wheel Nut Torque Specifications		
Thread Size	**Wheel Manufacturer**	**Torque (oiled): lbf·ft (N·m)**
M20 x 1.5	Accuride Corporation	280 to 330 (380 to 447)
	Alcoa Incorporated	
M22 x 1.5	Accuride Corporation	450 to 500 (610 to 678)
	Alcoa Incorporated	
1-1/8–16	Accuride Corporation	450 to 500 (610 to 678)
	Alcoa Incorporated	
3/4–16	Accuride Corporation	450 to 500 (610 to 678)
	Alcoa Incorporated	

Table 1, Wheel Nut Torque Specifications

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Driveline Inspecting	41–01
Driveline Lubricating	41–02

41–01 Driveline Inspecting

Driveline Inspection

⚠ WARNING

Do not service or inspect a driveshaft with the engine running. A rotating driveshaft can cause serious personal injury.

Loose end yokes, excessive radial looseness, slip spline radial looseness, bent shaft tubing, or missing plugs in the slip yoke can cause universal joint and bearing defects.

See **Fig. 1** for an illustration of the ArvinMeritor™ Full-Round driveline. See **Fig. 2** for an illustration of the ArvinMeritor™ Easy Service™ or 1/2 Round driveline.

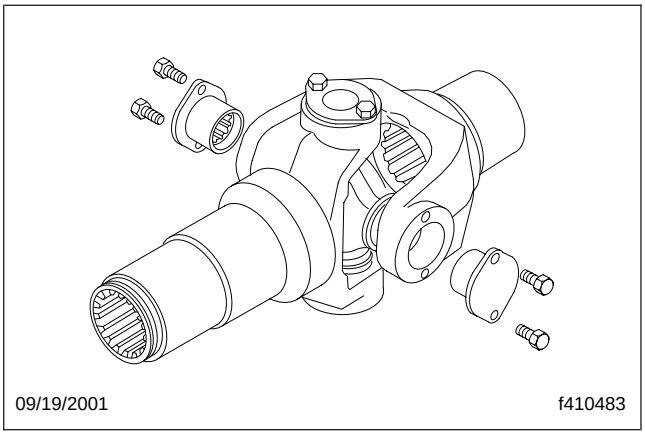


Fig. 1, Full-Round Driveline

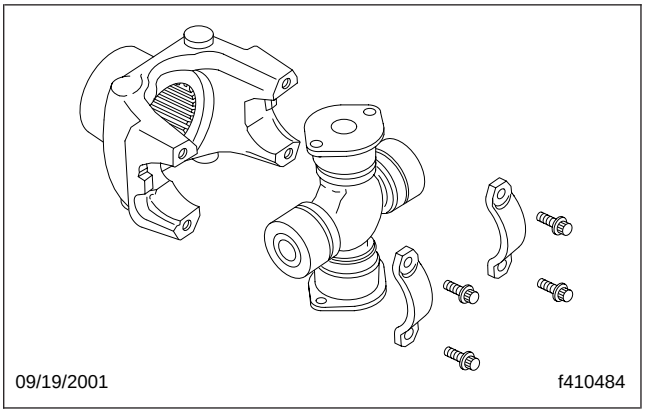


Fig. 2, Easy Service (1/2 Round) Driveline

1. Check the output and input end yokes on both the transmission and axle for axial looseness. Refer to the axle or transmission manufacturer's service information for the correct specifications.

   If loose, disconnect the driveshaft. For instructions, see **Group 41** of the *Business Class® M2 Workshop Manual*. Tighten the end yoke retaining nut to the proper specification. Refer to the axle or transmission manufacturer's service information for the correct specifications.

2. Inspect for worn universal joints. Apply a vertical force of about 50 pounds to the driveline near the universal joints. If there is any movement, replace the universal joint. For instructions, see **Group 41** of the *Business Class® M2 Workshop Manual*.

3. Examine the slip yoke spline for excessive radial movement. See **Fig. 3**. If excessive radial looseness exists between the slip yoke and the tube shaft, replace the slip yoke and the tube shaft. For instructions, see **Group 41** of the *Business Class® M2 Workshop Manual*.

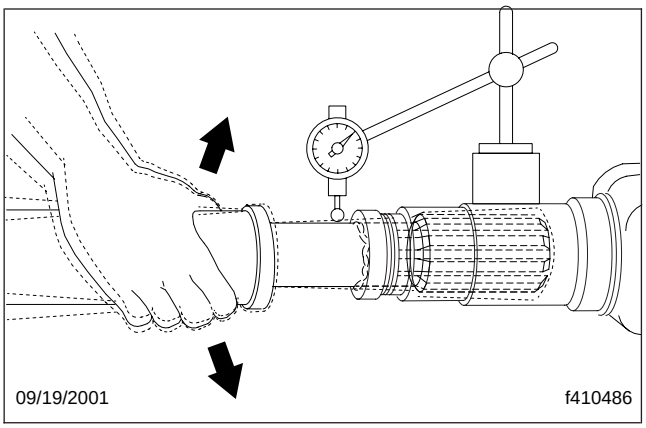


Fig. 3, Examine the Slip Yoke Spline

4. Examine the shaft for damaged or bent tubing. Carefully remove any foreign material, such as mud or dirt on the shaft.

41–02 Driveline Lubricating

Driveline Lubrication

The Full-Round and Easy Service drivelines require periodic lubrication of the universal joints and slip

yoke splines. See **Fig. 4** for the areas that need lubrication. See **Table 1** for approved lubricants.

Approved Lubricants	
Lubricant and Specification	**Lubricant Brands**
Universal joint, slip joint, and spline grease must meet ArvinMeritor Specification O–634–B (NLGI Grade No. 2, Lithium 12-Hydroxy Stearate with Molybdenum Disulfide)	Phillips Petroleum Philube MW–EP2 Grease
	Exxon 5160
	Amalie All Purpose Grease with Moly–L1–2M
	Shell Super Duty Special FF
	Marathon Maralube Molycode 529
	Shell Moly Poly Grease
	Kendall L424 Grease
	Amoco Super Chassis Grease
	Ford Specification M1C–75B or part number PN™C1AZ 19590

Table 1, Approved Lubricants

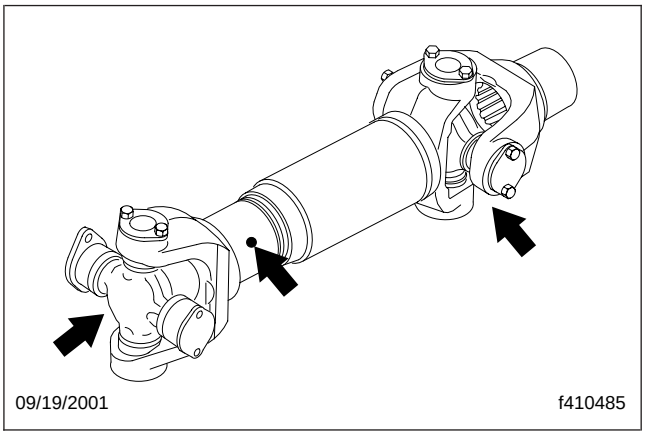


Fig. 4, Lubrication Areas for Full-Round and Easy Service Drivelines

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Air Brake Inspecting and Leak Testing	42–13
Air Brake System Valve Inspecting	42–01
Air Dryer AD–9, AD–IP, AD–IS/DRM Checking	42–10
Bendix AD–9 Air Dryer Desiccant Replacing	42–02
Bendix AD–IP Air Dryer Desiccant Replacing	42–05
Bendix AD–IS Air Dryer Desiccant Replacing	42–09
Bendix Hydro-Max® Brake System Inspecting	42–16
Bosch Hydraulic Brake System Inspecting	42–04
Brake Inspecting	42–15
Brake Lines and Fittings Inspecting, Hydraulic Brakes	42–11
Brake Pedal Linkage and Mounting Plate Inspecting	42–12
Foot-Control Valve, E-6, Inspecting and Lubricating	42–14
Governor D–2A Checking	42–03
Haldex and Gunite Slack Adjuster Lubricating	42–06
Meritor Camshaft Bracket Lubricating	42–07
Meritor Slack Adjuster Lubricating	42–08

42–01 Air Brake System Valve Inspecting

IMPORTANT: There is no scheduled (Bendix) air valve maintenance that requires disassembly of the valve within the warranty period. If the valve does not function within the warranty period, do not disassemble the part as this will void the warranty.

See the following maintenance operations for information about Bendix air valve maintenance.

42–02 Bendix AD–9 Air Dryer Desiccant Replacing

IMPORTANT: For vehicles equipped with an oil-coalescing air dryer desiccant cartridge, replace the cartridge once a year, regardless of mileage.

1. Park the vehicle on a level surface, apply the parking brakes, and chock the tires.
2. Completely drain all air reservoirs. Air pressure gauges should read 0 psi (0 kPa).

IMPORTANT: The compressor discharge line may contain residual air pressure.

3. Identify, tag, and disconnect the three air lines from the end cover.
4. Disconnect the harness connector from the heater and thermostat assembly.
5. Loosen the capscrew that secures the upper mounting bracket strap.
6. Remove the two capscrews that sencure the air dryer to the lower mounting bracket. Mark the position of the mounting bracket to the end cover and mark the capscrews to ease installation.
7. Remove the upper mounting bracket strap capscrew, and remove the air dryer from the vehicle.
8. Place the air dryer on a bench and remove the remaining six capscrews, 12 washers, six nuts, and the air dryer housing. See **Fig. 1**. Discard the nuts. Remove the end-cover-to-housing O-ring.
9. Clamp the desiccant cartridge in a vise.

⚠ WARNING

Clamping the end cover or housing in a vise could seriously compromise the air dryer's ability to hold air pressure, which could cause a failure in the brake system, resulting in property damage, personal injury, or death.

10. Twist the end cover counterclockwise to release the cartridge from the end cover. Rotate the end cover until it completely separates from the desiccant cartridge.

NOTE: A substantial torque, up to 50 lbf·ft (68 N·m), may be necessary to remove the desiccant cartridge.

11. Remove and discard desiccant cartridge O-rings.

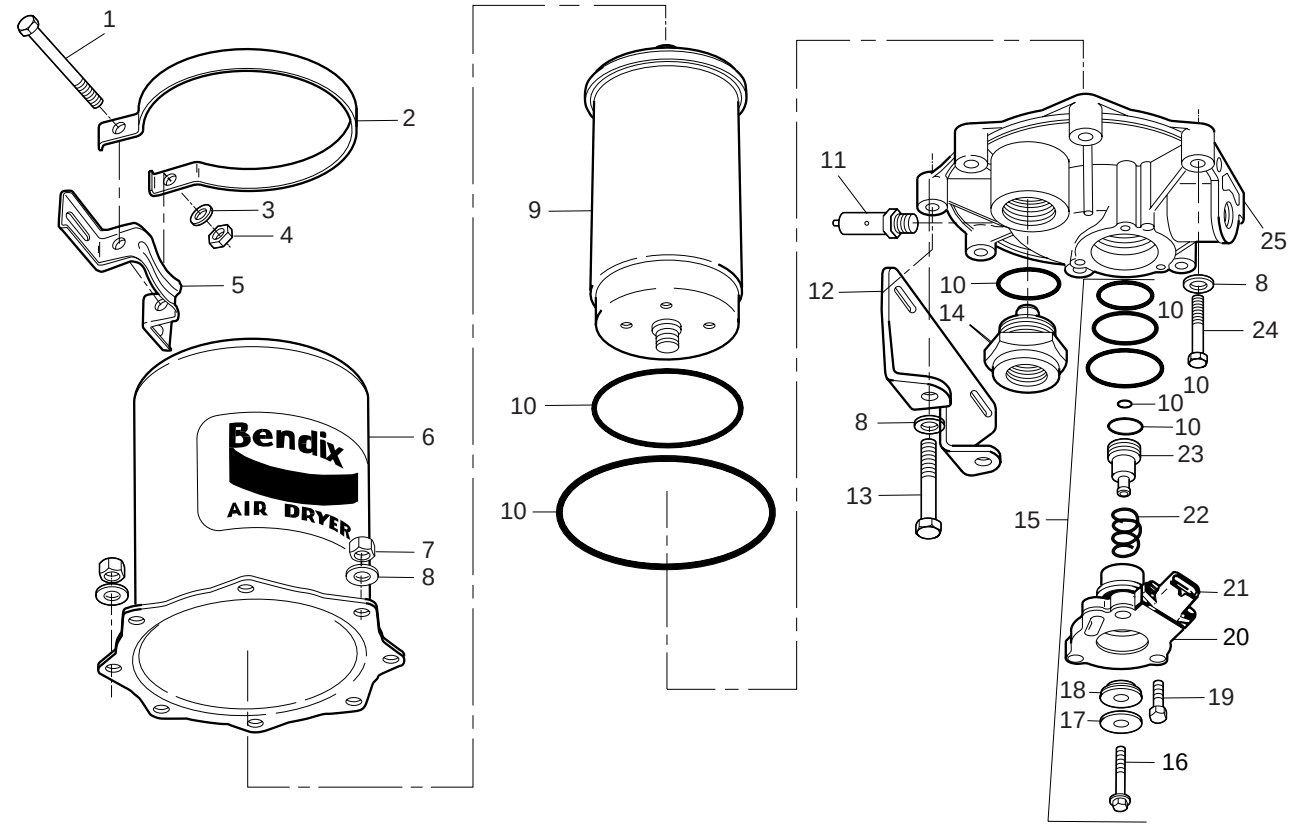
NOTICE

Dirt or obstructions in the O-ring grooves can cause an O-ring failure that will result in an air leak.

12. Lubricate new O-rings with grease supplied in the kit and install them in the end cover.
13. Install the desiccant cartridge on the end cover. Turn the cartridge clockwise until the desiccant cartridge makes contact with the end cover.
14. Place the desiccant cartridge in a vise, and turn the end cover clockwise an additional 180 to 225 degrees to fully tighten the desiccant cartridge to the end cover.

NOTE: Desiccant cartridge torque should not exceed 50 lbf·ft (68 N·m).

15. Place the housing over the desiccant cartridge and align the mounting holes with the end cover.
16. Install the six bolts, 12 washers, and six new nuts. Torque the nuts in a star pattern 270 to 385 lbf·in (3060 to 4340 N·cm). See **Fig. 2**.
17. Install the air dryer on the lower mounting bracket. Install the two previously marked bolts, four washers, and two new nuts. Torque the two remaining nuts 270 to 385 lbf·in (3060 to 4340 N·cm). Install the bolt, two washers, and a new nut in the upper mounting bracket strap. Torque the upper mounting bracket strap nut 80 to 120 lbf·in (904 to 1356 N·cm).



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1. 5/16 x 4-1/2 Upper Mounting Bracket Capscrew
2. Upper Mounting Bracket Strap
3. 5/16-Inch Lockwasher
4. 5/16-Inch Nylok® Nut
5. Upper Mounting Bracket
6. Housing
7. Nylok Nut
8. 3/8-Inch Special Washer
9. Desiccant Cartridge
10. O-Ring
11. Drain Valve
12. Lower Mounting Bracket
13. 3/8-Inch Bolt (long)
14. Check Valve Assembly
15. Purge Valve Assembly
16. Purge Valve Bolt
17. Exhaust Diaphragm
18. Purge Valve
19. 1/4-Inch Screw
20. Purge Valve Housing
21. Heater and Thermostat Housing
22. Return Spring
23. Purge Piston
24. 3/8-Inch Capscrew
25. End Cover

Fig. 1, AD-9 Air Dryer

18. Connect and tighten the three air lines. Connect the harness connector to the heater and thermostat assembly until the lock tab snaps in place.
19. Start the engine, build the air pressure, and check the air brake system for leaks. If any air leaks are present, see **Group 42** of the *Business Class® M2 Workshop Manual* for diagnosis and repair information.

42–03 Governor D–2A Checking

IMPORTANT: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

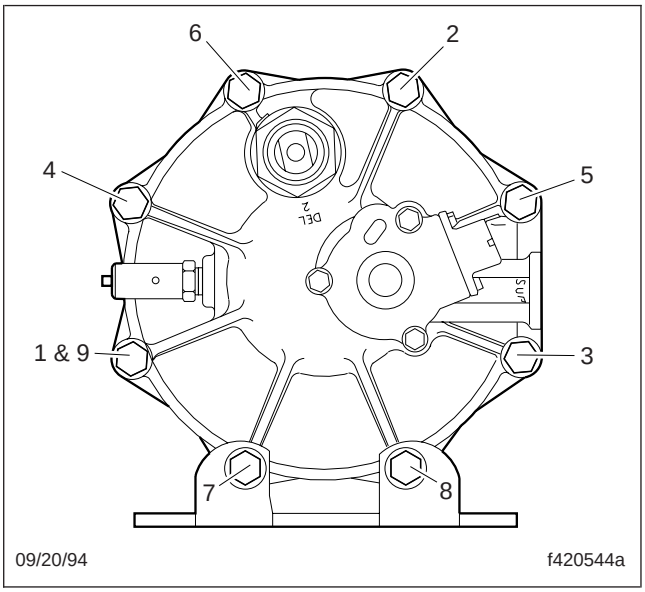


Fig. 2, End Cover to Housing Torque Pattern

Every 12 months, 100,000 miles (160 900 km), or 3600 operating hours, perform the operational test below.

Operational Test

1. Start the vehicle engine, build air pressure in the brake system, and check the pressure registered by a dash or test gauge at the time the governor cuts-out, stopping the compression of air by the compressor. Cut-out pressure should be in accordance with the pressure setting of the piece number being used. Common cut-out pressures are 125 to 135 psi (862 to 931 kPa). With the engine still running, make a series of brake applications to reduce the air pressure, and observe at what pressure the governor cuts-in the compressor. As in the case of cut-out pressure, cut-in pressure should be in accordance with the pressure setting of the piece number being used. Cut-in pressure is 105 psi (724 kPa).

NOTE: If the governor cover is marked nonadjustable, and the adjusting stem has been sheared off, this is a non-serviceable governor and it must be replaced with a new or remanufactured unit.

2. Never condemn or adjust the governor pressure settings unless they're checked with an accurate test gauge or a dash gauge that's registering accurately. If the pressure settings of the D-2 governor are inaccurate or it's necessary that they be changed, the adjustment procedure follows.

   2.1 Remove the top cover from the governor.

   2.2 Loosen the adjusting screw locknut.

   2.3 To raise the pressure setting, turn the adjusting screw counterclockwise; to lower the setting, turn the screw clockwise. Be careful not to overadjust. Each 1/4 turn of the adjusting screw raises or lowers the pressure setting approximately 4 psi (28 kPa).

   2.4 When proper adjustment is obtained, tighten the adjusting screw locknut, and install the top cover. The pressure range between cut-in and cut-out is not adjustable.

Cut-In Position

Apply soap solution around the cover and to the exhaust port. Slight bubble leakage is permitted. Excessive leakage indicates a faulty inlet valve or faulty lower piston O-ring.

Cut-Out Position

Apply soap solution around the cover and to the exhaust port. Slight bubble leakage is permitted. Excessive leakage indicates a faulty exhaust valve seat, exhaust stem O-ring, or O-ring at the top of the piston.

If the governor does not function as described, or if leakage is excessive, it is recommended that it be replaced with a new or remanufactured unit, or repaired with genuine Bendix parts.

42–04 Bosch Hydraulic Brake System Inspecting

Before checking lining wear with the wheel removed, review the following brake lining exposure warnings.

⚠ WARNING

Breathing brake lining dust (asbestos or non-asbestos) could cause lung cancer or lung disease. Unless exposure can be reduced below legal limits, wear an air purifying respirator approved by MSHA or NIOSH at all times when servicing the

brakes, starting with removal of the wheels and continuing through assembly.

To minimize the possibility of creating airborne brake lining dust, clean the dust from the brake rotor, brake caliper, and brake assembly, using an industrial-type vacuum cleaner equipped with a high-efficiency filter system. Then, using a rag soaked in water and wrung until nearly dry, remove any remaining dust. Do not use compressed air or dry brushing to clean the brake assembly.

1. Check lining wear, as follows.
   - 1.1 Apply the parking brakes. Chock the tires to prevent vehicle movement.
   - 1.2 Remove one or more of the lining inspection plugs, and measure brake lining thickness.
   - 1.3 On front and rear axles, replace linings worn to less than 1/16 inch (1.6 mm).
   - 1.4 Make sure that the brake rotor and linings are free of oil and grease.
   - 1.5 Install the inspection plug(s).
2. If the wheel and hub assembly is removed from the axle, check lining wear. Replace the linings on all brake assemblies if worn to less than 1/16 inch (1.6 mm) at the thinnest point. Check the brake pads for wear and replace, as necessary.

42–05 Bendix AD–IP Air Dryer Desiccant Replacing

IMPORTANT: For vehicles equipped with an oil-coalescing air dryer desiccant cartridge, replace the cartridge once a year, regardless of mileage.

1. With the vehicle parked on a level surface, apply the parking brakes, and chock the tires.
2. Using a wrench or a socket, loosen the desiccant cartridge bolt. Then separate the desiccant cartridge from the end cover.
3. Pull the cartridge bolt out of the cover and remove the cartridge.

⚠ WARNING

Do not attempt to disassemble the desiccant cartridge assembly. Parts for the assembly are not available and the cartridge contains a 150 lb spring that cannot be mechanically caged. Disassembly could release the spring, resulting in personal injury.

4. Remove and discard both O-rings from the cartridge bolt.
5. Using a clean rag, wipe clean the inside of the end cover. Clean the cartridge bolt bore in the end cover, and the sealing surfaces for the large- and small-diameter desiccant cartridge sealing rings.
6. Inspect the end cover for physical damage, then inspect all air line fittings for corrosion; replace as necessary.
7. Clean and inspect the bolt, paying attention to the threads and O-ring grooves.

IMPORTANT: Use only the grease supplied with Bendix replacement kits.

8. Lubricate the O-rings, bolt O-ring grooves, sealing rings, and cartridge grooves. Lubricate the end cover bore for the bolt.
9. Install both O-rings on the cartridge bolt, then, using a twisting motion, insert the assembled desiccant cartridge bolt in the end cover.
10. Install the desiccant cartridge on the end cover, making sure the cartridge is properly seated and flush on the end cover.

NOTE: It may be necessary to rotate the cartridge slightly until the anti-rotation lugs are properly aligned and allow the cartridge to rest flush against the end cover.

11. Using a wrench or socket, tighten the desiccant cartridge bolt 70 lbf·ft (95 N·m). **Do not** overtorque.
12. Before placing the vehicle in service, perform the test below.
    - 12.1 Close all reservoir drain cocks.
    - 12.2 Build system pressure to governor cut-out, and note that the AD-IP air dryer purges with an audible escape of air.
    - 12.3 Fan the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a purge at the AD-IP air dryer exhaust.

12.4 Check for excessive leakage around the head of the desiccant cartridge where it contacts the end cover. With the compressor in loaded mode (compressing air), apply a soapy solution to these areas, and observe that any leakage does not exceed a 1-inch bubble in 1 second. If leakage exceeds this measure, remove and re-install the desiccant cartridge.

42–06 Haldex and Gunite Slack Adjuster Lubricating

IMPORTANT: Perform **MOP 42-15** before lubricating the slack adjusters.

Automatic slack adjusters that have a grease fitting must be lubricated periodically to ensure proper brake operation.

⚠ WARNING

Failure to lubricate slack adjusters could lead to dragging brakes or a brake failure, resulting in property damage, personal injury, or death.

Haldex

⚠ CAUTION

Do not use moly-disulfide-loaded grease or oil. Both the life and reliability of the slack adjuster will be reduced if this type of grease is used.

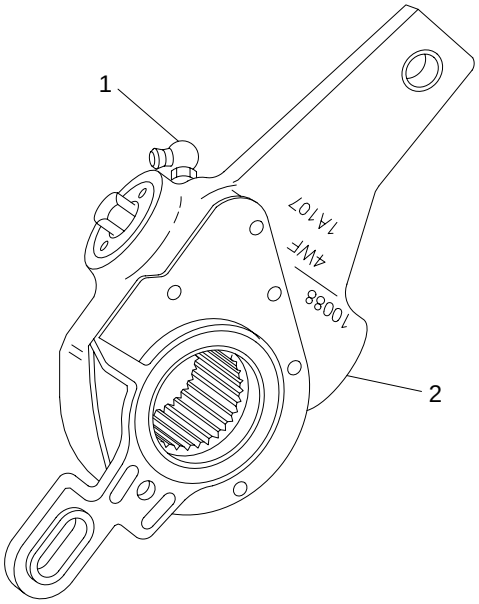
Lubricate the automatic slack adjuster at the grease fitting. See **Fig. 3**. Use standard chassis lubricant for Haldex slack adjusters.

Gunite

For operating temperatures of –20°F (–29°C) and higher, use Texaco Multifak EP-2 or Mobil Grease No. 77.

For operating temperatures between –20°F (–29°C) and –40°F (–40°C), use Lubriplate Aero grease.

Lubricate a Gunite automatic slack adjuster at the grease fitting until grease appears on the camshaft, or flows from the grease relief. See **Fig. 4**.



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1. Grease Fitting
2. Slack Adjuster

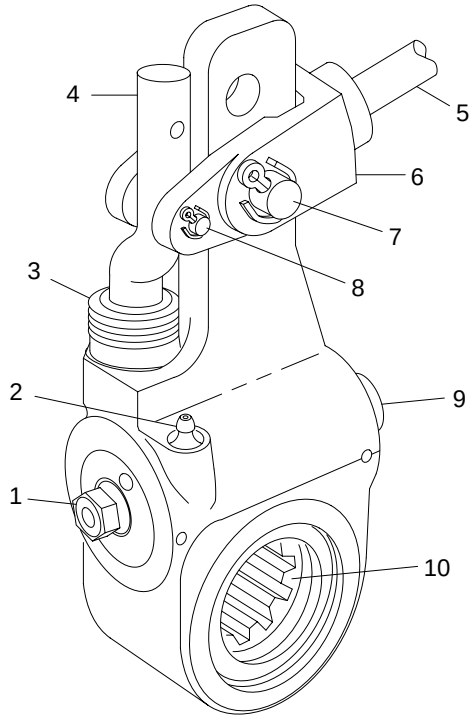
Fig. 3, Haldex Slack Adjuster Grease Fitting

The newest Gunite automatic slack adjusters are produced without a grease relief. During lubrication with a grease gun, the lubricant is forced through the drilled worm wheel onto the camshaft. Lubricate the automatic slack adjuster at the grease fitting until grease appears on the camshaft. See **Fig. 5**.

42–07 Meritor Camshaft Bracket Lubricating

IMPORTANT: Perform **MOP 42-15** before lubricating the camshaft brackets.

NOTE: If equipped with an extended-maintenance Q Plus™ brake system, the camshaft bracket will not have a grease fitting. These camshafts use a special NLGI grade synthetic polyurea grease, and do not require lubrication for 3 years or 500,000 miles (800 000 km), whichever comes first. Extended-maintenance camshaft bushings are lubricated during the brake reline service interval. For ser-



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1. 7/16-Inch Adjusting Nut
2. Grease Fitting
3. Boot
4. Link
5. Brake Chamber Piston Rod
6. Clevis
7. 1/2-Inch Clevis Pin
8. 1/4-Inch Clevis Pin
9. Grease Relief Opening
10. Slack Adjuster Spline

Fig. 4, Gunite Automatic Slack Adjuster

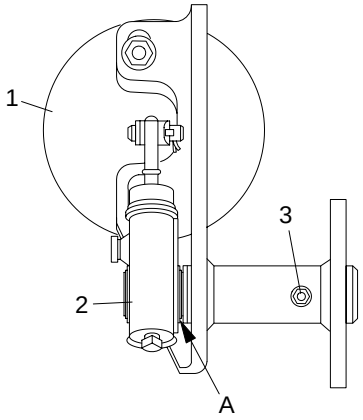
vice and lubrication instructions, see **Group 42** of the *Business Class® M2 Workshop Manual*.

For camshaft brackets with grease fittings, use an NLGI Grade 1 or Grade 2 multipurpose chassis grease.

Lubricate the camshaft bushings through the grease fitting on the camshaft bracket or the spider until new grease flows from the inboard seal. See **Fig. 5**.

⚠ WARNING

If grease leaks out under the camhead, the camshaft bracket grease seal is worn or damaged. See Group 42 of the *Business Class® M2 Workshop Manual* for grease seal replacement instructions. If this seal is not replaced, the brake linings could become contaminated with grease. The stopping distance of the vehicle will be increased, which could result in personal injury or property damage.



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A. Grease Exit
1. Brake Chamber
2. Slack Adjuster
3. Non-Pressure-Relief Grease Fitting

Fig. 5, Camshaft Bracket Lubrication

42–08 Meritor Slack Adjuster Lubricating

IMPORTANT: Perform **MOP 42-15** before lubricating the slack adjusters.

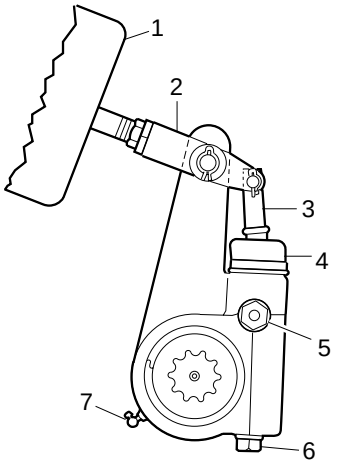
NOTE: If equipped with an extended-maintenance Q Plus™ brake system, the slack adjuster will not have a grease fitting. These slack adjusters use a special NLGI grade synthetic polyurea grease, and do not require lubrication for 3 years or 500,000 miles (800 000 km), whichever comes first. Extended-maintenance slack adjusters are lubricated during the brake reline service interval. For service and lubrication instructions, see **Group 42** of the *Business Class® M2 Workshop Manual*.

For slack adjusters with grease fittings and for operating temperatures above –40°F (–40°C), use an NLGI Grade 1 clay-base grease or an NLGI Grade 1 or 2 lithium-base grease.

For slack adjusters with grease fittings, and for operating temperatures below –40°F (–40°C) and above

–65°F (–54°C), use an NLGI Grade 2 synthetic oil or a clay-base grease.

Lubricate the slack adjuster at the grease fitting until grease is forced past the pressure-relief capscrew or past the gear splines around the inboard snap ring. See **Fig. 6**.



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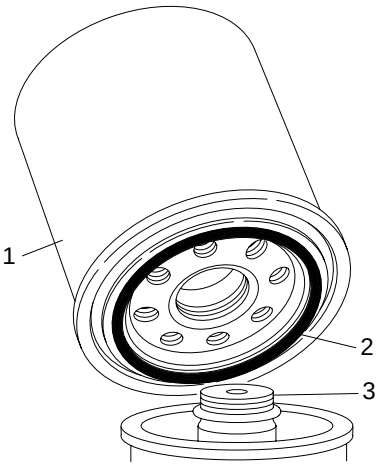
1. Brake Chamber
2. Clevis
3. Actuator Rod
4. Boot
5. Pull-Pawl Seal
6. Manual Adjusting Nut
7. Grease Fitting (or plug)

Fig. 6, Meritor Automatic Slack Adjuster

42–09 Bendix AD–IS Air Dryer Desiccant Replacing

IMPORTANT: For vehicles equipped with an oil-coalescing air dryer desiccant cartridge, replace the cartridge once a year, regardless of mileage.

1. With the vehicle parked on a level surface, apply the parking brakes, and chock the tires.
2. Drain the air dryer by operating the drain valve on the AD-IS purge reservoir located below the dryer.
3. Using a strap wrench or equivalent, loosen the desiccant cartridge. Spin the cartridge off by hand and discard it.
4. On the new desiccant cartridge, lubricate the sealing ring with silicone grease. See **Fig. 7**.



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1. Desiccant Cartridge
2. Cartridge Sealing Ring
3. Threaded Base Post

Fig. 7, Desiccant Cartridge Replacement

IMPORTANT: Use only the silicone grease supplied with Bendix replacement kits.

5. Screw the desiccant cartridge onto the body by hand until the seal makes contact with the body. Rotate the cartridge clockwise about one full turn. Tighten the cartridge firmly.
6. Before placing the vehicle in service, perform the following tests:
   - 6.1 Close all reservoir drain cocks.
   - 6.2 Build system pressure to governor cut-out, and note that the AD-IS air dryer purges with an audible escape of air.
   - 6.3 Fan the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a purge at the AD-IS air dryer exhaust.
   - 6.4 It is recommended by Bendix that the following leakage tests be made to ensure that the AD-IS air dryer will not cycle excessively:
     - Compressor unloader mechanism
     - Governor
     - Drain cock and safety valve in first (supply) reservoir.

- All air connections leading to and from the first (supply) reservoir.

42–10 Air Dryer AD–9, AD–IP, AD–IS/DRM Checking

IMPORTANT: Review the warranty policy before performing any intrusive maintenance procedures. An extended-warranty may be voided if intrusive maintenance is performed during this period.

Because no two vehicles operate under identical conditions, maintenance and maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for any one particular operation.

Every 900 operating hours, or 25,000 miles (40 225 km), or 3 months:

1. Check for moisture in the air brake system by opening reservoir drain valves and checking for the presence of water. If moisture is present, the desiccant cartridge may require replacement; however, the following conditions can also cause water accumulation and should be considered before replacing the desiccant:
   - 1.1 An outside air source has been used to charge the system. This air did not pass through the drying bed.
   - 1.2 Air usage is exceptionally high and not normal. This may be due to high air system leakage.
   - 1.3 In areas where more than a 30-degree range of temperature occurs in one day, small amounts of water can temporarily accumulate in the air brake system due to condensation. Under these conditions, the presence of small amounts of moisture is normal.

NOTE: A small amount of oil in the system is normal and should not be considered as a reason to replace the desiccant cartridge. Some oil at the dryer exhaust is normal.

2. Visually check for physical damage such as chaffed or broken air and electrical lines and broken or missing parts.
3. Check mounting bolts for tightness. Torque 30 to 35 lbf·ft (41 to 47 N·m).
4. Perform the operational and leakage tests listed below.

Operational and Leakage Tests

1. Check all lines and fittings leading to and from the air dryer for leakage and integrity. Repair any leaks found.
2. Build system pressure to governor cutout, and note that the dryer purges with an audible escape of air. Watch the system pressure and note the pressure fall-off for a 10-minute period. If the pressure drop exceeds 1 psi/minute from either service reservoir for a single vehicle; or 3 psi/minute for a tractor trailer, inspect the vehicle air systems for sources of leakage, and repair them. Refer to troubleshooting information in Bendix service literature.
3. Check for excessive leakage around the purge valve with the compressor in the loaded mode (compressing air). Apply a soap solution to the purge valve exhaust port and observe that leakage does not exceed a 1-inch (25-mm) bubble in 1 second. If the leakage exceeds the maximum specified, refer to troubleshooting information in the Bendix service literature.
4. Build system pressure to governor cutout, and note that the dryer purges with an audible escape of air. Fan the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a dryer purge. If the system does not follow this pattern, refer to troubleshooting information in the Bendix service literature.
5. Check operation of the end cover heater and thermostat assembly during cold weather, as follows:
   - 5.1 Electric Power to the Dryer: With the ignition or engine kill switch in the ON position, check for voltage to the heater and thermostat assembly using a voltmeter or testlight. Unplug the electrical connector at the air dryer and place the test leads on each of the connections of the female connector on the vehicle power lead. If there is no voltage, look for a blown fuse, broken wires, or corrosion in the vehicle

wiring harness. Check to see if a good ground path exists.

5.2 Thermostat and Heater Assembly Operation: These tests are not possible except in cold-weather operation. Turn off the ignition switch, and cool the thermostat and heater assembly to below 40°F (4°C). Using an ohmmeter, check resistance between the electrical pins in the air dryer connector half. Resistance should be 1.5 to 3.0 ohms for the 12-volt heater assembly, and 6.0 to 9.0 ohms for the 24-volt heater assembly.

NOTE: Some models of the AD-9 may have a resistance reading of 1.0 to 2.5 ohms.

Warm the thermostat and heater assembly to approximately 90°F (32°C) and again check the resistance. Resistance should exceed 1000 ohms. If resistance values obtained are within stated limits, the thermostat and heater assembly is operating properly. If resistance values obtained are outside stated limits, replace the heater and thermostat assembly.

6. On the AD-IS/dryer reservoir module (DRM) only, observe the pressure gauges of the vehicle as system pressure builds from zero. The primary gauge should rise until it reaches approximately 109 ±5 psi (751 ±34 kPa), then level off (or a momentary slight fall) as the second pressure protection valve opens supplying the secondary reservoir. When the secondary pressure gauge passes through approximately 55 ±5 psi (379 ±34 kPa) and then 85 ±5 psi (586 ±34 kPa) there should be an associated levelling off (or momentary slight fall) of pressure as the third and fourth pressure protection valves open. Finally, both the primary and secondary gauges should reach their full pressure of approximately 130 ±5 psi (896 ±34 kPa). If the AD-IS does not perform within the pressure ranges described above, recheck using gauges known to be accurate. If readings remain outside the ranges outlined above, replace the AD-IS.

   There are no kits available for servicing the pressure protection valves.

⚠ WARNING

Do not attempt to adjust or service the pressure protection valves. Incorrect pressure protection valve settings can result in automatic application of the vehicle spring brakes without prior warning. This can cause personal injury or property damage.

42–11 Brake Lines and Fittings Inspecting, Hydraulic Brakes

Chock the tires, release park brake, and make a full-service brake application.

Replace damaged or leaking components, and tighten loose fittings.

42–12 Brake Pedal Linkage and Mounting Plate Inspecting

Inspect the pedal, pedal linkage, and mounting plate assembly for proper operation, to ensure that any problems believed to be valve-related are not actually mechanism issues.

42–13 Air Brake Inspecting and Leak Testing

IMPORTANT: If any of the tests in the following procedure fail, refer to **Group 42** of the *Business Class® M2 Workshop Manual* to test individual air brake components and valves.

⚠ WARNING

Some steps in this operation require the parking brakes to be released. Make sure the vehicle is on a level surface and all tires are chocked. Failure to do so could result in the vehicle rolling, causing personal injury and/or vehicle damage.

1. With the vehicle parked on a level surface, shut down the engine, apply the parking brakes, and chock all tires.

2. Completely drain all air reservoirs.
3. Install accurate test gauges in the primary and secondary reservoirs.
4. Start the engine and run it at a fast idle.
5. Record reservoir pressures when the low-pressure warning turns off.
6. Record governor cut-out pressure and air dryer purge pressure.
7. Reduce service air pressure by applying and releasing the service brakes several times, and record governor cut-in pressure.
8. Charge the air system to governor cut-out, shut down the engine, and apply the parking brakes.
9. Allow pressure to stabilize for one minute.
10. Observe the installed service reservoir gauges. The pressure should not drop more than 10 psi (69 kPa) within five minutes.
11. If necessary, start the engine and charge the air system. Shut down the engine and release the parking brakes.
12. Make and hold a full service brake application, allowing the pressure to stabilize for one minute. Observe the installed service reservoir gauges. The pressure should not drop more than 15 psi (103 kPa) in five minutes.
13. With the air system at full pressure and the engine idling, perform the following:
    - On trucks, operate the parking brake control valve and note that the parking brakes apply and release promptly as the control valve knob is pulled out and pushed in on the spring brake axles only.
    - On tractors, operate the trailer supply control valve knob. Note the air coming out of the trailer control coupling. Operate the park control knob and note that the parking brakes apply and release promptly as the knob is pulled out and pushed in. Block the trailer supply coupling, and push the trailer supply control valve and park control valve knobs in. When the park control valve knob is pulled out, the trailer supply knob should also come out.
14. Build air system pressure to cut-out and shut down the engine.
15. Completely drain the secondary (front axle) reservoir. On vehicles equipped with a Dryer Reservoir Module (DRM) or AD-IS with the air dryer attached to the reservoir, the primary (rear axle) reservoir pressure should not drop below 65 psi (448 kPa). On vehicles equipped with single check valves, where the air dryer is not attached to the reservoir, the primary reservoir should not lose pressure.
16. Make a service brake application. The rear axle brakes should apply and release and the brake lights should illuminate.

    On tractors, with the trailer supply knob pushed in, the trailer control coupling should deliver air during the brake application.
17. Push the trailer air supply valve knob in. With the secondary reservoir still completely drained, slowly drain the primary reservoir and record the pressure at which the knob automatically comes out. This pressure should be 20 to 45 psi (138 to 310 kPa).
18. Close the drain cocks, recharge the system, and completely drain the primary reservoir. On vehicles equipped with a DRM or AD-IS with the air dryer attached to the reservoir, the secondary reservoir pressure should not drop below 65 psi (448 kPa). On vehicles equipped with single check valves, where the air dryer is not attached to the reservoir, the secondary reservoir should not lose air pressure.
19. On tractors only:
    - 19.1 Start the engine and build the system air pressure to governor cut-out.
    - 19.2 Shut down the engine and leave the parking brakes released.
    - 19.3 Completely drain the primary reservoir.
    - 19.4 Make a modulated service brake application by depressing the brake pedal. The front brakes should apply and release and the brake lights should illuminate. In addition to the front brakes, with the trailer supply knob pushed in, the trailer control coupling should deliver air during the brake application.
20. On trucks only:
    - 20.1 Start the engine and charge the air system until governor cut-out.

20.2 Shut down the engine and leave the parking brakes released.

20.3 Completely drain the primary reservoir.

20.4 Make a modulated service brake application. Both front and rear brakes should modulate. At a steady full brake application, the pressure should not drop more than 10 psi (69 kPa) within five minutes.

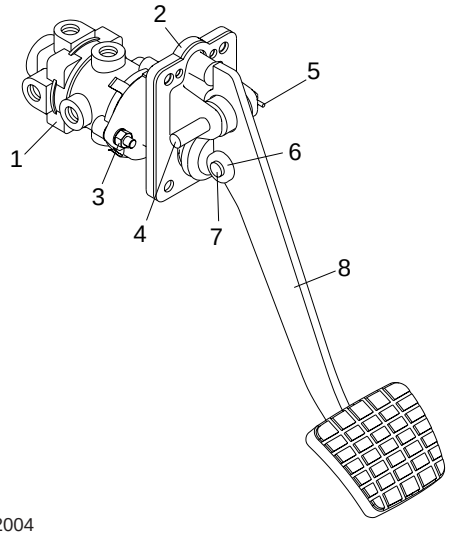
21. Drain all reservoirs and remove the gauges from the service reservoirs. Close the reservoir drain cocks.
22. Remove the chocks from the tires.

42–14 Foot-Control Valve, E-6, Inspecting and Lubricating

This procedure will be performed during M5 maintenance intervals.

- Severe service = 32k
- Short-haul transport = 128k
- Long-haul transport = 160k

1. Remove the brake valve from the vehicle. See **Section 42.09, Subject 110** of the *Business Class® M2 Workshop Manual* for instructions.
2. Remove the roll pin from the brake pedal pivot pin. See **Fig. 8**.
3. Remove the brake pedal pivot pin.
4. Remove the brake pedal.
5. Check the brake pedal mounting plate adapter for signs of wear or cracks at the bosses (the area from which the pivot pin was removed). Replace it if necessary.
6. Check the brake pedal rollers for signs of wear or cracks. Replace the rollers if necessary.
7. If the rollers are replaced, replace the roller pin, install a new cotter pin, bend it 90 degrees, and apply Torque Seal (OPG F900 White) to the cotter pin.
8. Remove the plunger from the valve. Clean the existing grease from the plunger, using alcohol. Check the plunger for signs of wear or cracks. Replace it if necessary.



1. Foot-Control Valve, E-6
2. Mounting Plate
3. Nut and Washer
4. Pivot Pin
5. Roll Pin
6. Roller
7. Roller Pin
8. Pedal

Fig. 8, Brake Pedal and Valve Assembly

9. Lubricate the plunger with synthetic grease of NLGI Grade 1.5, such as 76 Triton synthetic EP Grease (FTL Sped 48-25432-000).
10. Insert the plunger in the valve.
11. Install the brake pedal with the pivot pin.
12. Install a new roll pin, then apply Torque Seal (OPG F900 White) to the roll pin.
13. Install the brake valve assembly. See **Section 42.09, Subject 110** of the *Business Class® M2 Workshop Manual* for instructions.
14. Test the brakes before returning the vehicle to service.

42–15 Brake Inspecting

IMPORTANT: This procedure should be performed prior to lubrication of the brake components.

Parking Brake Operational Check

CAUTION

Perform the following check in a clear safe area. If the parking brakes fail to hold the vehicle, personal injury or property damage may result.

1. With the engine running, and air pressure at cut-out pressure, set the parking brake.
2. Put the vehicle in the lowest gear and gently attempt to move it forward. The vehicle should not move. If the vehicle moves, the parking brakes are not operating correctly and must be repaired before the vehicle is returned to service. See **Group 42** of the *Business Class® M2 Workshop Manual* for repair procedures.

Brake Component Inspection

1. Park the vehicle on a level surface, set the parking brake, and chock the tires. Once the tires are chocked, release the parking brake.

WARNING

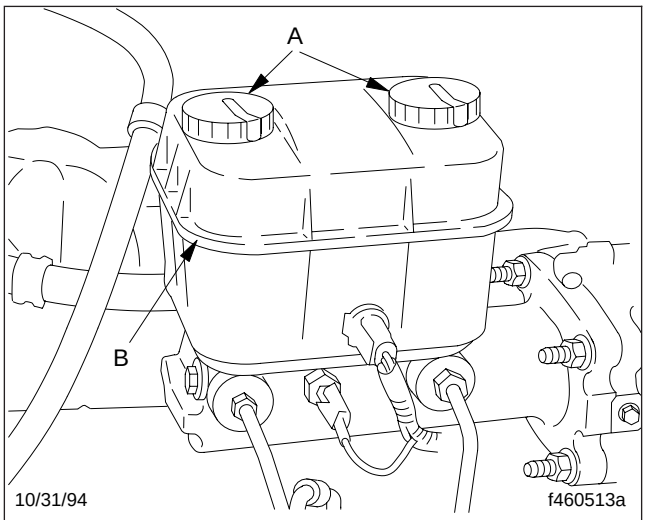
Manually adjusting an automatic slack adjuster to bring the pushrod stroke within legal limits is likely masking a mechanical problem. Adjustment is not repairing. Before adjusting an automatic slack adjuster, troubleshoot the foundation brake system and inspect it for worn or damaged components. Improperly maintaining the vehicle braking system may lead to brake failure, resulting in property damage, personal injury, or death.

2. With the engine off, and 100 psi (689 kPa) of air tank pressure, have an assistant apply and hold an 80 to 90 psi (550 to 620 kPa) brake application.
3. Check to see if the colored over-stroke band on each brake chamber pushrod is exposed.

   If a band shows, the stroke is too long. Check the foundation brake components for wear or damage, and repair as needed. See **Group 42** of the *Business Class® M2 Workshop Manual* for inspection, troubleshooting, and repair procedures.
4. Measure the applied chamber stroke. See **Table 1** for the proper stroke for the type of chamber being used. If the stroke is too short, the brakes may drag or will not fully apply. Check for improper operation or adjustment of the automatic slack adjuster. See **Group 42** of the *Business Class® M2 Workshop Manual* for inspection and troubleshooting procedures.
5. Start the engine and build air pressure to at least 100 psi (689 kPa). Shut down the engine.
6. Check all of the foundation brake components for damage, wear, and loose or missing parts. Repair as needed. See **Group 42** of the *Business Class® M2 Workshop Manual* for repair procedures.

42–16 Bendix Hydro-Max® Brake System Inspecting

1. Check the fluid level in the hydraulic brake fluid reservoir. If needed, fill the reservoir up to the ridge that surrounds the reservoir. See **Fig. 9**. Use only heavy-duty brake fluid, DOT 6.



A. Open caps and check fluid level.
B. Fill to this level.

Fig. 9, Hydraulic Brake Fluid Reservoir

2. Check all hydraulic lines and fittings for damage, leakage, or looseness.

   Replace damaged or leaking components, and tighten loose fittings.
3. Check the brake module for leaks. If leaks are found, repair or replace the brake module. See

Group 42 of the *Business Class M2 Workshop Manual* for replacement instructions, or take the vehicle to an authorized Freightliner dealer.

4. Check the electrical connections and harnesses. Make sure the connectors are fully seated and the harnesses are not chafed or cut. Repair or replace any damaged harness. Disconnect any loose connectors and inspect the terminals for corrosion. If corrosion is present, replace the terminals. If corrosion is not present, reconnect the connector.
5. Check the fuse for the hydraulic brake booster pump, as follows.
   - 5.1 Open the cover to the main power distribution module (PDM).
   - 5.2 Pull the fuse in position F6 for the Hydro-Max relay.
   - 5.3 Inspect the relay to make sure the fuse is not damaged. If the fuse is damaged, install a new fuse. If the fuse is not damaged, install the fuse in position F6.
   - 5.4 Close the PDM cover.
6. Check the operation of the Hydro-Max brake booster, as follows.
   - 6.1 With the engine off, depress the brake pedal; the warning light and buzzer should come on, and the electric motor should run.
   - 6.2 Start the engine and allow the gauges to sweep. Depress the brake pedal; no warning lights, buzzer, or electric motor should come on.

Brake Chamber Stroke Specifications

Chamber			Max Applied Stroke: inch (mm)
Manufacturer	**Type***	**Size†**	
Gunite	Standard Stroke	9	1 3/8 (35)
		12	
		16	1 3/4 (45)
		20	
		24	
		30	2 (51)
		36‡	2 1/4 (57)
	Long Stroke	16	2 (51)
		20	
		24	
		24	2 1/2 (64)
		30	
Haldex	Standard Stroke	12	1-3/8 (35)
		16	1-3/4 (44)
		20	
		24	
	2-1/2-Inch Extended Stroke	24	2 (51)
	3-Inch Extended Stroke	24	2-1/2 (64)
	Standard Stroke	30	2 (51)
	Long Stroke	30	2-1/2 (64)

Brake Chamber Stroke Specifications			
Chamber			Max Applied Stroke: inch (mm)
Manufacturer	Type*	Size†	
Meritor	Standard Stroke	9	Less than 1-1/2 (38)
		12	
		16	Less than 1-3/4 (44)
		20	
		24	Less than 1-7/8 (48)
	Long Stroke	24	Less than 2 (51)
	Standard Stroke	30	

* Long stroke design is indicated by a tag, or embossing, on the brake chamber.

† Specifications are relative to a brake application with 80 to 90 psi (550 to 620 kPa) air pressure in the brake chambers.

‡ If type 36 chamber is used, slack length should be less than 6 inches.

Table 1, Brake Chamber Stroke Specifications

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Drag Link Inspecting	46–01
Drag Link Lubricating	46–05
Power Steering Filter Changing	46–06
Power Steering Fluid Changing	46–02
Power Steering Fluid Level Inspecting	46–03
Power Steering Gear Lubricating	46–04

46–01 Drag Link Inspecting

WARNING

All steering system components are critical for safe operation of the vehicle. Failure to maintain the steering system as specified may result in loss of steering control, which could lead to personal injury and property damage.

Have someone turn the steering wheel from left to right. Check for movement between the ball stud end at both the pitman arm and the steering arm. Also check if the ball stud nut is loose.

If the ball stud end is loose, replace the drag link. If the ball stud nut is loose, replace the nut and cotter pin. See **Group 00** for proper torque specifications.

Inspect the boot of the drag link at both the pitman arm and the steering arm end for cracks, splits, or other damage. Replace the boot as needed. See **Group 46** of the *Business Class® M2 Workshop Manual* for drag link removal and installation instructions.

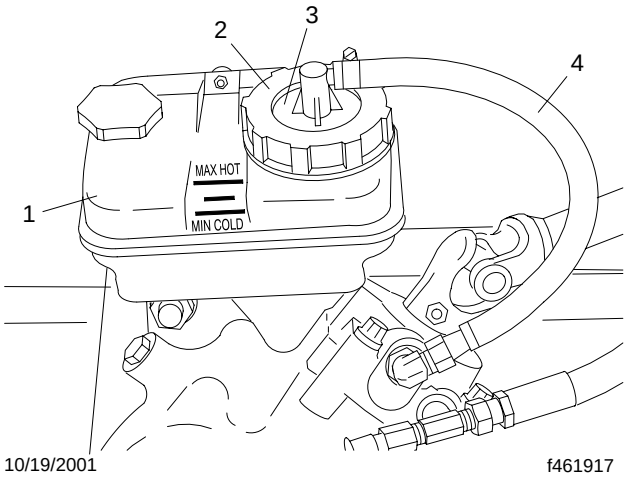
Grasp the drag link near the pitman arm end, and move the drag link side to side to check for axial movement in the ball stud end. If it is loose, replace the drag link. See **Group 46** of the *Business Class® M2 Workshop Manual* for replacement instructions. If there is 1/8-inch (3-mm) movement or more, do not drive the vehicle until the drag link is replaced.

46–02 Power Steering Fluid Changing

WARNING

Fill only with approved clean fluid. Failure to use the proper fluid could cause seal deterioration and leaks. Fluid leaks could eventually cause loss of power steering assist. This could lead to an accident resulting in personal injury or property damage. Wear eye protection when changing the fluid and filter.

1. Apply the parking brakes and chock the rear tires.
2. Place a drain pan under the power steering reservoir.
3. Remove the retaining ring from the reservoir. See **Fig. 1**.



1. Power Steering Reservoir
2. Retaining Ring
3. Filter Cover
4. Return Hose

Fig. 1, Power Steering Reservoir

4. Remove the filter and filter cover from the reservoir. Drain the fluid from the filter into the drain pan. Leave the filter hanging over the drain pan.
5. Remove the bolts, nuts, and washers that attach the power steering reservoir to the mounting bracket. Drain the power steering fluid from the reservoir, but do not remove the supply line to the reservoir.
6. Using bolts, nuts, and washers, attach the reservoir to the mounting bracket.
7. Fill the reservoir with an approved power steering fluid to the line between the MIN COLD and MAX HOT lines. See **Fig. 1**. See **Table 1** for approved power steering fluids.

Approved Power Steering Fluids	
Fluid Type*	**Approved Fluid***
Automatic Transmission Fluid	Dexron® III
	Dexron® II

* Do not mix fluid types. Refer to the text in this group for a detailed warning statement.

Table 1, Approved Power Steering Fluids

8. Raise the front of the vehicle and support it with jack stands.

9. Start the engine and operate it at idle. Turn the steering wheel from full left to full right several times until clean oil starts flowing from the power steering filter. Add fluid to the reservoir to maintain the fluid level between the MIN COLD and MAX HOT lines.
10. Shut down the engine and install the filter and filter cover in the reservoir. Make sure that the gasket under the filter cover is not damaged. If the gasket is damaged, replace it. Install the gasket on the reservoir.
11. Attach the retaining ring to the reservoir to secure the filter and filter cover.
12. Start the engine and check that the power steering fluid level is between the MIN COLD and MAX HOT lines. Add more power steering fluid if needed.
13. Raise the vehicle, remove the jack stands, and lower the vehicle.
14. Remove the chocks from the tires.

46–03 Power Steering Fluid Level Inspecting

1. Apply the parking brakes and chock the rear tires.
2. With the engine cool, the fluid level should be between the MIN COLD and MAX HOT lines with the engine off.
3. Add or remove fluid as necessary to bring the fluid level to the line between the MIN COLD and MAX HOT lines. See **Table 1** for approved power steering fluids.
4. With the engine hot, the fluid level should be at the MAX HOT line with the engine off.
5. Add or remove fluid as necessary to bring the fluid level to the MAX HOT line. See **Table 1** for approved power steering fluids.
6. Remove the chocks from the tires.

46–04 Power Steering Gear Lubricating

TRW THP Series

⚠ CAUTION

Apply grease to the sector shaft with only a hand-type grease gun. Use of a high-pressure power grease gun will supply grease too quickly and could affect the high pressure seal, contaminating the hydraulic fluid.

Using a hand-type grease gun, apply NLGI Grade 2 or 3 multipurpose chassis grease until it starts to come out past the sector shaft seal.

46–05 Drag Link Lubricating

1. Using a clean rag, wipe all dirt from both drag link grease fittings.
2. Using a pressure gun, apply grease at the grease fittings until old grease is forced out of the socket. Use multipurpose chassis grease NLGI Grade 2 (8% 12-hydroxy lithium stearate grease) or NLGI Grade 1 (6% 12-hydroxy lithium stearate grease).

NOTE: NLGI Grade 2 is the preferred grade.

46–06 Power Steering Filter Changing

1. Apply the parking brakes and chock the rear tires.
2. Raise the front of the vehicle and support it with jack stands.
3. Remove the retaining ring from the reservoir. See **Fig. 1**.
4. Remove the filter, filter cover, and gasket from the reservoir.
5. Disconnect the filter from the filter cover, and discard the filter.
6. Apply a thin film of power steering fluid on the gasket of the new filter. Then attach the filter to the filter cover.

7. Check for damage to the gasket that was removed from the reservoir. If the gasket is damaged, replace it. Install the gasket on the reservoir.
8. Install the filter and filter cover in the reservoir. Attach the retaining ring to the reservoir to secure the filter and filter cover.
9. Check the fluid level in the reservoir. If necessary, add fluid to the reservoir to maintain the fluid level between the MIN COLD and MAX HOT lines. See **Table 1** for approved power steering fluids.
10. Raise the vehicle and remove the jack stands, then lower the vehicle.
11. Remove the chocks from the tires.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
CNG Fuel Cylinder Inspecting	47–07
CNG Fuel System Inspecting	47–05
CNG High-Pressure Fuel Filter Element Replacing	47–06
Fuel Tank Band Nut Tightening	47–01
Fuel/Water Separator Element Replacing	47–02
LNG Fuel System Inspecting	47–03
LNG Vacuum Integrity Testing	47–04

47–01 Fuel Tank Band Nut Tightening

IMPORTANT: Do not overtighten the nuts.

Rectangular Fuel Tank

Hold the retention nut on the fuel tank band with a wrench while backing off the jam nut. Then tighten the retention nut 13 to 17 lbf·ft (18 to 23 N·m). After the retention nut has been tightened, hold the retention nut with a wrench while tightening the jam nut 13 to 17 lbf·ft (18 to 23 N·m).

Cylindrical Fuel Tank

Hold the retention nut on the fuel tank band with a wrench while backing off the jam nut. Then tighten the retention nut 30 to 35 lbf·ft (41 to 46 N·m). After the retention nut has been tightened, hold the retention nut with a wrench while tightening the jam nut 30 to 35 lbf·ft (41 to 46 N·m).

47–02 Fuel/Water Separator Element Replacing

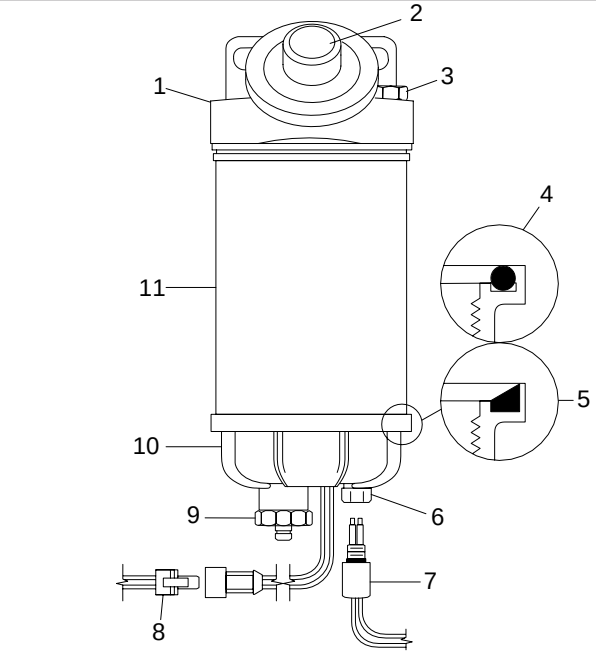
Alliance

The only maintenance necessary on an Alliance fuel/water separator is to replace the filter element.

⚠ WARNING

Diesel fuel is flammable and can ignite if exposed to an open flame, intense heat, or other ignition source. Do not drain fuel near, or expose fuel vapor to open flame or intense heat. Exposure to open flame or intense heat could start a fire, possibly resulting in personal injury or property damage. When working on a fuel system, have a fire extinguisher within easy reach.

1. Drain off some fuel by loosening the vent plug and opening the drain valve. See **Fig. 1**.
2. Disconnect the water sensor and heater connections if equipped.
3. Remove the element and bowl together, by turning counterclockwise.



1. Mounting Head
2. Fuel Primer Pump
3. Vent Plug
4. Bowl O-Ring
5. Bowl Gasket
6. Bowl Probe Plug
7. Water Sensor Probe
8. Heater Connector
9. Drain Plug
10. Sight Bowl
11. Filter Element

Fig. 1, Alliance Fuel/Water Separator

4. Remove the bowl from the element and clean the O-ring gland.
5. Apply a coating of clean fuel or motor oil to the new O-ring and element seal.
6. Spin the bowl onto the new element, then spin them both onto the filter head, snugly, by hand only.

IMPORTANT: Do not use tools to tighten the bowl and element.

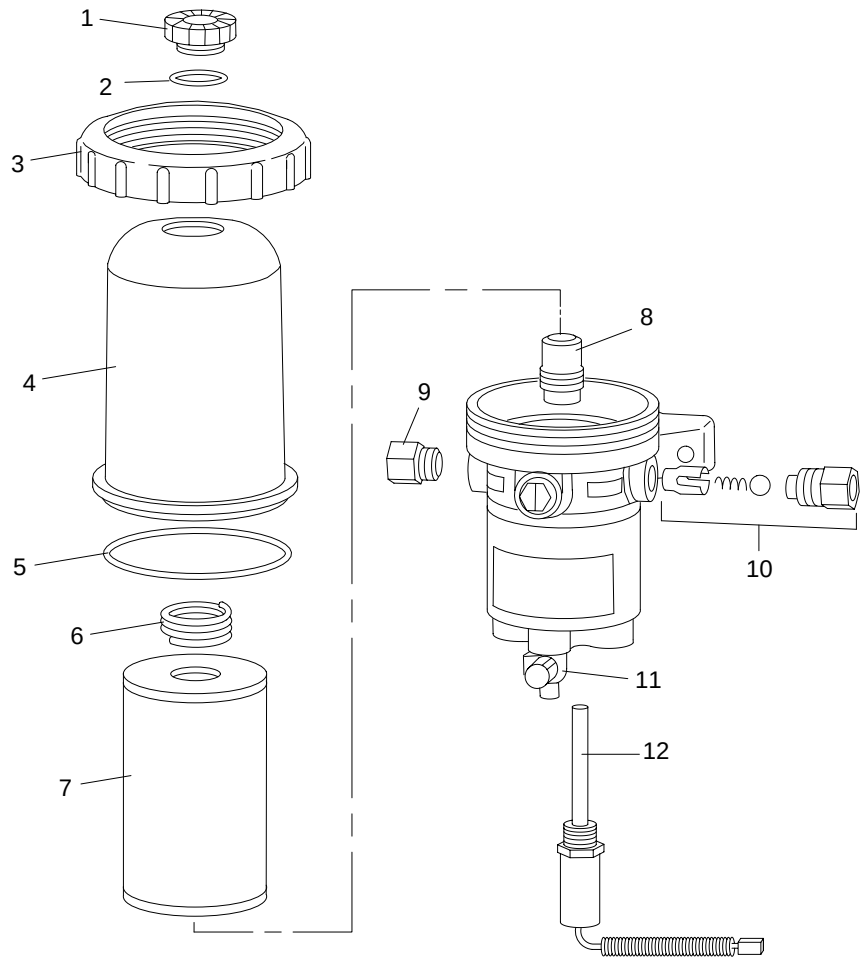
7. Connect the water sensor and heater connectors if equipped.
8. If equipped with a primer pump, prime the fuel/water separator.
   - 8.1 Loosen the vent plug. Then operate the primer pump until the fuel purges at the vent plug.
   - 8.2 Close the vent plug.

9. Start the engine and check for fuel leaks.
10. Shut down the engine and correct any fuel leaks.

Davco Fuel Pro® 232 and 233

Replace the fuel/water separator element (**Fig. 2**) only when the filter element is completely covered.

In the event of an emergency, when the filter needs replacement but a Davco filter is not available, a temporary filter can be used. For instructions, see **Chapter 14** of the *Business Class® M2 Driver's Manual.*



1. Filter Vent
2. Vent Seal
3. Filter Collar
4. Filter Cover
5. Cover Seal
6. Filter Spring
7. Filter Element
8. Temporary Filter Stud
9. Fuel Outlet
10. Check Valve Fuel Inlet
11. Drain
12. Electric Filter Preheater (optional)

Fig. 2, Davco Fuel Pro® 232 and 233

WARNING

Diesel fuel is flammable and can ignite if exposed to an open flame, intense heat, or other ignition source. Do not drain fuel near, or expose fuel vapor to open flame or intense heat. Exposure to open flame or intense heat could start a fire, possibly resulting in personal injury or property damage. When working on a fuel system, have a fire extinguisher within easy reach.

1. Drain the fuel below the collar level.
2. Using Davco wrench 232002, remove the filter collar. Then remove the filter cover.
3. Remove the element and dispose of it properly.
4. Install a new element. Make sure the grommet is in place on the filter stud.
5. Install a new cover seal on the filter cover.
6. Using the collar, attach the filter cover with the spring to the base.

IMPORTANT: Tighten the collar by hand only.

7. Remove the filter vent. Then fill the fuel/water separator with fuel until the fuel level is 1 inch (2.5 cm) above the collar.
8. Install the filter vent on the fuel/water separator.
9. Start the engine and raise the rpm for one minute to purge air.

Davco Fuel Pro® 382

Replace the fuel/water separator element only when the filter element is completely covered.

In the event of an emergency, when the filter needs replacement but a Davco filter is not available, a temporary filter can be used. For instructions, see **Chapter 13** of the *Business Class® M2 Driver's Manual*.

WARNING

Diesel fuel is flammable and can ignite if exposed to an open flame, intense heat, or other ignition source. Do not drain fuel near, or expose fuel vapor to open flame or intense heat. Exposure to open flame or intense heat could start a fire, possibly resulting in personal injury or property damage. When working on a fuel system, have a fire extinguisher within easy reach.

1. Drain the fuel below the collar level. See **Fig. 3**.
2. Using Davco wrench 380134 or 382002, remove the filter collar. Then remove the filter cover.
3. Remove the element and dispose of it properly.
4. Install a new element. Make sure the grommet is in place on the filter stud.
5. Install a new cover seal on the filter cover.
6. Using the collar, attach the filter cover with the spring to the base.

IMPORTANT: Tighten the collar by hand only.

7. Remove the filter vent. Then fill the fuel/water separator with fuel until the fuel level is 1 inch (2.5 cm) above the collar.
8. Install the filter vent on the fuel/water separator.
9. Start the engine and raise the rpm for one minute to purge air.

47–03 LNG Fuel System Inspecting

WARNING

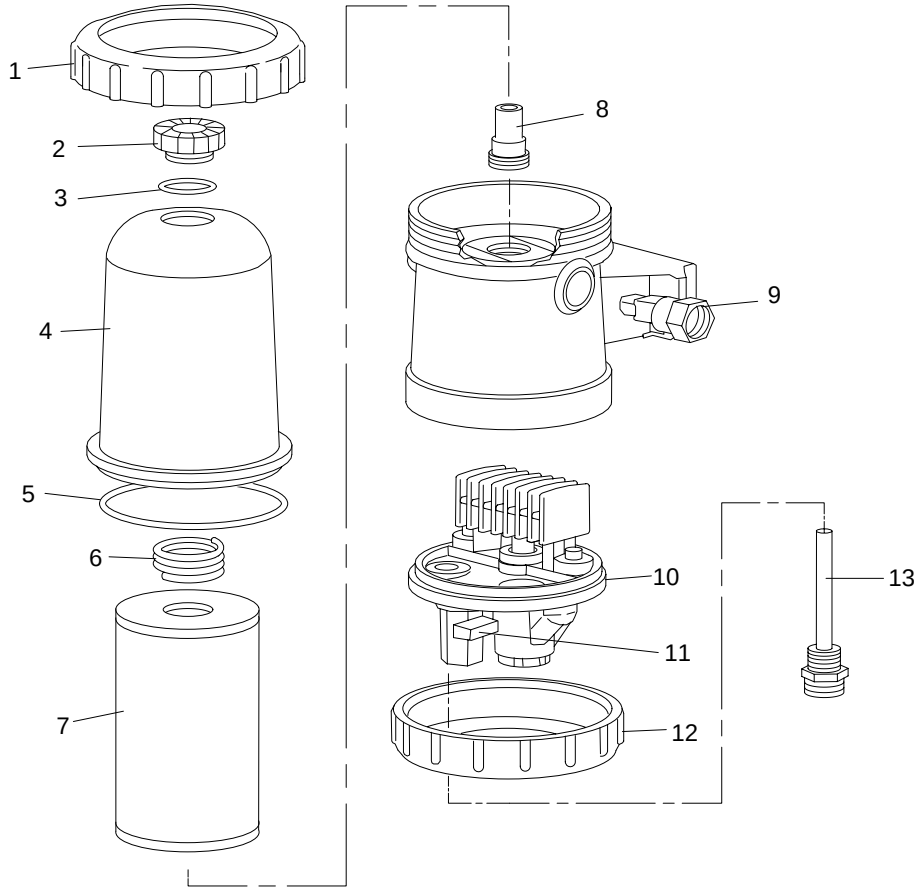
Natural gas is highly flammable. See the safety precautions listed in Chapter 16 of the *Business Class® M2 Driver's Manual* or *Group 47* of the *Business Class® M2 Workshop Manual*. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause serious bodily injury or death.

The following inspections must be performed by a qualified technician, in accordance with the manufacturer's established inspection criteria.

All tank components should be allowed to defrost before conducting the following inspections.

NOTICE

Do not use a high-pressure washer or steam cleaner on natural gas fuel system plumbing components, as this can introduce moisture and contaminants into the threads of the fittings and damage the sealants.



1. Filter Collar
2. Filter Vent
3. Vent Seal
4. Filter Cover
5. Cover Seal
6. Filter Spring
7. Filter Element
8. Temporary Filter Stud
9. Check Valve Fuel Inlet
10. Fluid Heater/Bottom Plate and Seal
11. Drain
12. Bottom Plate Collar
13. Electric Heater (optional)

Fig. 3, Davco Fuel Pro® 382

Gas detection sensors are located on the cab overhead console and in the engine compartment on the frontwall. The sensors are located in high areas, where rising gas vapors will pass by or accumulate. Do not use a high-pressure washer, steam cleaner, or silicone-based chemicals on the gas detection sensors, as this may permanently disable the sensors. When cleaning the vehicle, cover the sensors with a plastic covering. Keep the sensors covered until the area has been cleared of any cleaning fumes. Harsh chemicals and extremely high temperatures may damage the sensor.

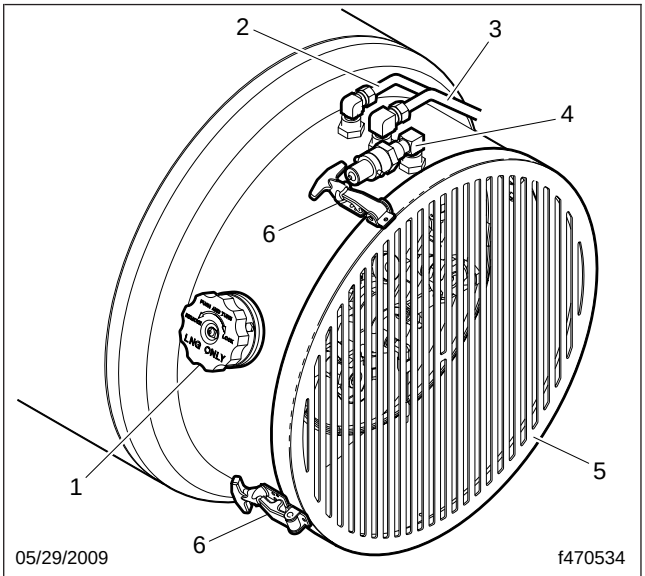
Fuel Tank and Shroud Inspecting

See **Fig. 4** for fuel tank and shroud component locations.

1. Inspect the fuel tank outer shell for dents or other signs of damage. Inspect the bottom of the tank for deep scratches, flat spots, or gouges.

   Replace a leaking fuel tank.

2. Ensure that the fuel tank is secured to its mounting brackets and that the mounting brackets are



1. Fuel Fill Fitting
2. Fuel Outlet Line (liquid)
3. Primary Relief Vent Line (relief valve)
4. Fill Vent Fitting (vent)
5. Shroud Cover
6. Shroud Cover Latches

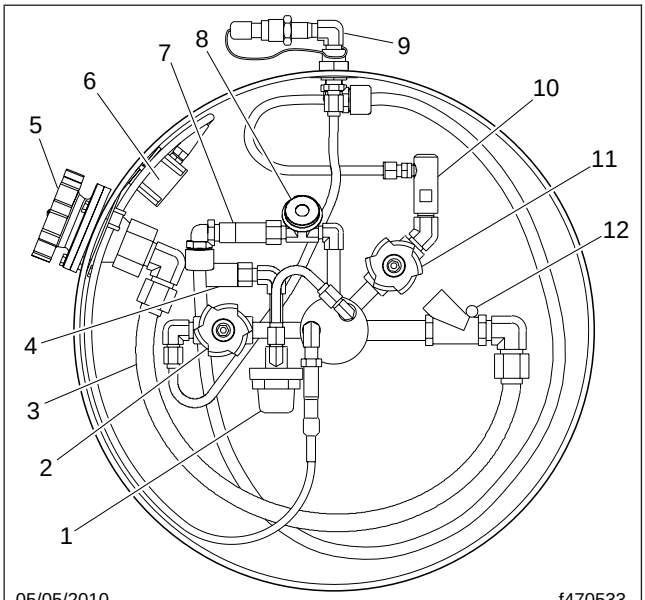
Fig. 4, Fuel Tank Outer Shell

secured to the frame. Inspect for any signs of looseness.

3. Ensure that all rubber isolator straps are present and secure.
4. Look for signs of abrasion between the fuel tank and mounting brackets.
5. Inspect the fuel fill fitting for signs of damage or leaks. Ensure the fuel fill cap is present and in good condition, and the fitting is mounted securely on the tank.
6. Inspect the fuel outlet line and fitting for signs of leaks or damage.
7. Inspect the primary relief vent and pipe-away line for damage, kinks, chafing, or loose connections.
8. Inspect the fill vent fitting for signs of damage.
9. Inspect the shroud cover for dents or other signs of damage. Ensure that the shroud cover latches are in working condition and fasten the shroud cover securely to the tank.
10. Replace leaking or damaged fuel lines. Repair or replace leaking or damaged fittings.

Plumbing Components Inspecting

See **Fig. 5** for plumbing component locations.



1. Pressure Control Regulator
2. Vapor Shutoff Valve
3. Fuel Fill Hose
4. Secondary Relief Valve (red cap)
5. Fuel Fill Fitting
6. Fuel Level Sender Box
7. Primary Relief Valve
8. Tank Pressure Gauge
9. Fill Vent Fitting
10. Excess Flow Valve
11. Fuel Shutoff Valve (liquid)
12. Fill Check Valve

Fig. 5, Fuel Tank Plumbing Components

Use a bubble solution to check for leaks while performing the following visual inspection.

1. Check the following components for signs of damage or leaks.
    - Pressure control regulator
    - Vapor shutoff valve
    - Secondary relief valve
    - Primary relief valve and threaded connections
    - Excess flow valve
    - Fuel shutoff valve

- Fill check valve

2. Inspect the fuel fill line for signs of damage, kinked or crushed piping, or chafing.
3. Ensure the red cap is present on the secondary relief valve.
4. Inspect the fuel tank pressure gauge for cracks in the sight glass. Ensure the indicator needle is present and in working condition. Inspect the gauge face for accuracy and legibility.
5. Inspect all vent lines for kinks, and signs of leaks or damage.
6. Replace leaking or damaged fuel lines. Repair or replace leaking or damaged fittings.

Fuel Level Sender Component Inspecting

1. Inspect the fuel level sender wiring harness for signs of loose connections or damage. Look for cracking or signs of moisture intrusion.
2. Inspect the fuel level sender box (**Fig. 5**, Item 6) for signs of leaks or damage. Ensure that the retainer clips are installed on the mounting ears.
3. Inspect all connectors and wiring for signs of loose connections, damage, or chafing.
4. Turn the ignition switch to the ON position and check for fuel gauge response.
5. Repair or replace any damaged fuel gauge components.

Vaporizer Inspecting

See **Fig. 6** for plumbing component locations.

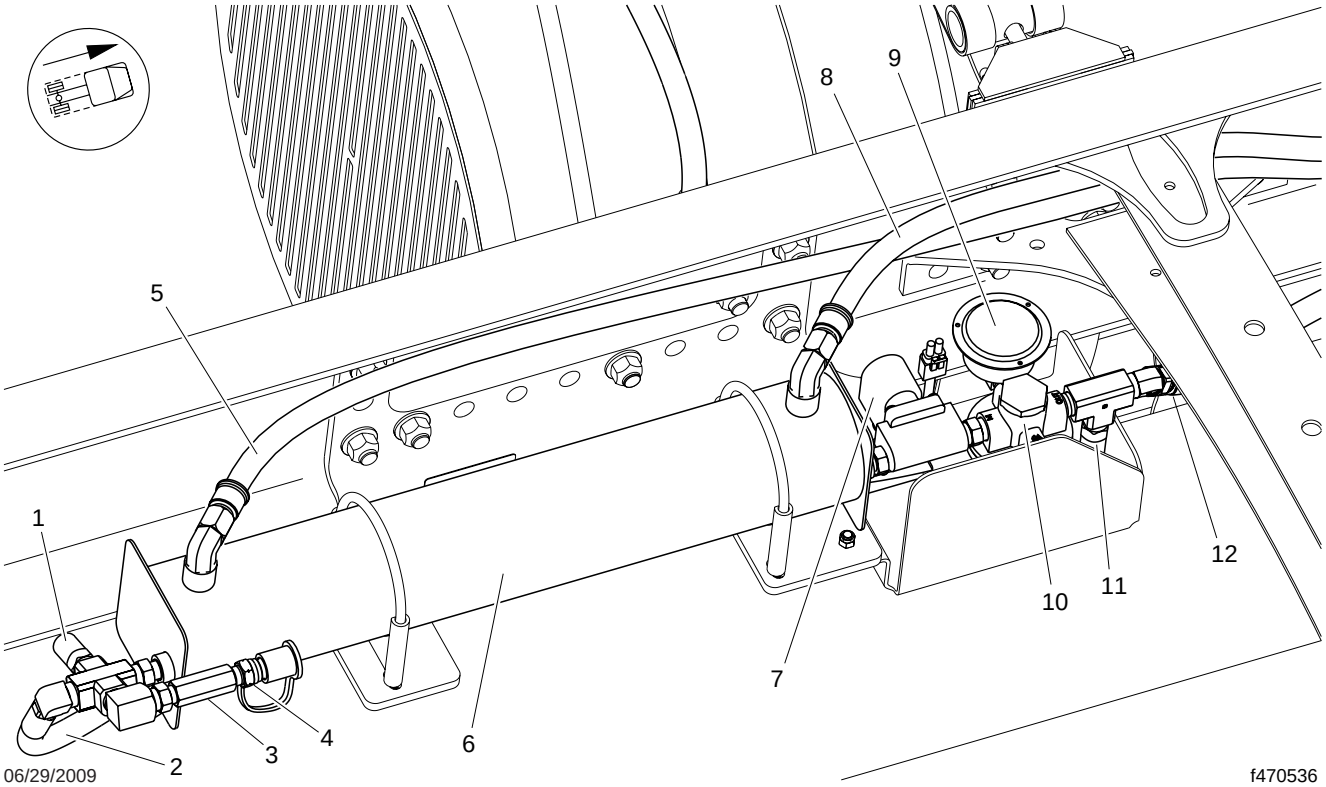
1. Ensure that the vaporizer is secured to its mounting brackets and that the mounting brackets are secured to the frame. Inspect for any signs of looseness.
2. Inspect the vaporizer fuel inlet and outlet lines for signs of chafing, damage, or leaks.
3. Inspect the vaporizer coolant hoses for signs of chafing, damage, or leaks.
4. Inspect all fittings for leaks.
5. Inspect the fuel shutoff solenoid valve for signs of leaks or damage. Inspect the solenoid mounting bracket for looseness.
6. Inspect the overpressure regulator for signs of leaks or damage.
   - 6.1 Ensure that the regulator is mounted securely.
   - 6.2 Check the overpressure regulator fittings for signs of leaks or damage.
   - 6.3 Ensure that the adjustment handle locking nut (at the bottom of the overpressure regulator) is tightened securely.
   - 6.4 Inspect the pressure gauge for damage. Ensure that the gauge sight glass is clear and legible.
7. Repair or replace any leaking or damaged vaporizer components.

47–04 LNG Vacuum Integrity Testing

WARNING

Natural gas is highly flammable. See the safety precautions listed in Chapter 16 of the *Business Class® M2 Driver's Manual* or *Group 47* of the *Business Class® M2 Workshop Manual*. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause serious bodily injury or death.

1. Ensure the fuel tank is between 50 and 75 percent full.
2. Check the fuel tank pressure gauge (**Fig. 5**, Item 8) to ensure that pressure is within the normal range of 120 to 150 psi (827 to 1034 kPa).
3. Inspect the fuel tank for signs of frost spots or outer surface sweating. Frosting or condensation on the outer surface of the fuel tank may indicate a loss of vacuum.
4. Check for a large variance in temperatures between the fuel tank and the fuel tank shroud. A large variance in temperatures between the fuel tank and the shroud may indicate a loss of vacuum.
5. Operate the vehicle for ten minutes. Shut down the engine, apply the parking brakes, and note the time.



1. Pressure Relief Device
2. Fuel Inlet Line
3. Check Valve
4. CNG Quick-Connect Port
5. Coolant Inlet Line
6. Vaporizer
7. Fuel Shutoff Solenoid Valve
8. Coolant Outlet Line
9. Pressure Gauge
10. Overpressure Regulator
11. Pressure Relief Valve
12. Fuel Outlet Line

Fig. 6, LNG Vaporizer Assembly

6. Wait fifteen minutes after shutting down the engine, then record the fuel tank pressure and note the time.
7. Allow the vehicle to stand for at least eight hours, then record the fuel tank pressure again.
8. Use **Table 1** to determine whether the pressure increase is within an acceptable range.

Vacuum Integrity Test Results	
Pressure Increase Over Eight-Hour Period	**Remedy**
Less than 20 psi (138 kPa)	None – Tank is normal
20 to 50 psi (138 to 345 kPa)	Monitor tank and test vacuum integrity again at next maintenance date
More than 50 psi (345 kPa)	Remove vehicle from service and evacuate the tank per the tank manufacturer's instructions

Table 1, Vacuum Integrity Test Results

47–05 CNG Fuel System Inspecting

⚠ WARNING

Natural gas is highly flammable. See the safety precautions listed in Chapter 16 of the *Business Class® M2 Driver's Manual* or *Group 47* of the *Business Class® M2 Workshop Manual*. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause serious bodily injury or death.

The following inspections must be performed by a qualified technician, in accordance with the manufacturer's established inspection criteria.

NOTICE

Do not use a high-pressure washer or steam cleaner on natural gas fuel system plumbing components, as this can introduce moisture and contaminants into the threads of the fittings and damage the sealants.

Gas detection sensors are located on the cab overhead console and in the engine compartment on the frontwall. The sensors are located in high areas, where rising gas vapors will pass by or accumulate. Do not use a high-pressure washer, steam cleaner, or silicone-based chemicals on the gas detection sensors, as this may permanently disable the sensors. When cleaning the vehicle, cover the sensors with a plastic covering. Keep the sensors covered until the area has been cleared of any cleaning fumes. Harsh chemicals and extremely high temperatures may damage the sensor.

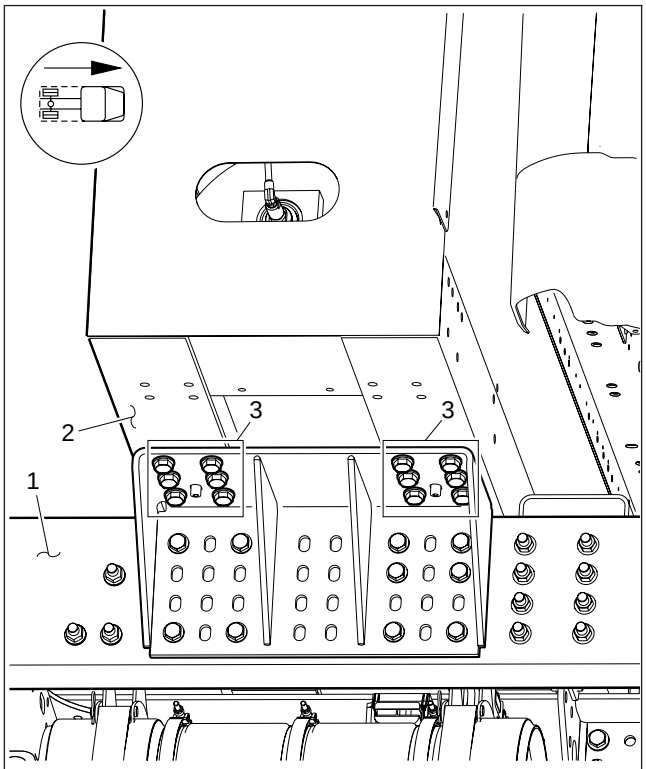
Use a bubble solution to check for leaks while performing the following inspection.

1. Inspect the fuel cylinders for dents or other signs of damage.

   Replace any leaking fuel cylinders.

2. Ensure that the fuel cylinders are secured within the fuel cylinder storage box.

3. Ensure that the fuel cylinder storage box is secured to the frame. Inspect for any signs of looseness. If necessary, tighten the storage box mounting bolts 160 lbf·ft (217 N·m). See **Fig. 7**.



1. Frame Rail
2. CNG Fuel Cylinder Storage Box
3. Mounting Bolts (qty 12 per side)

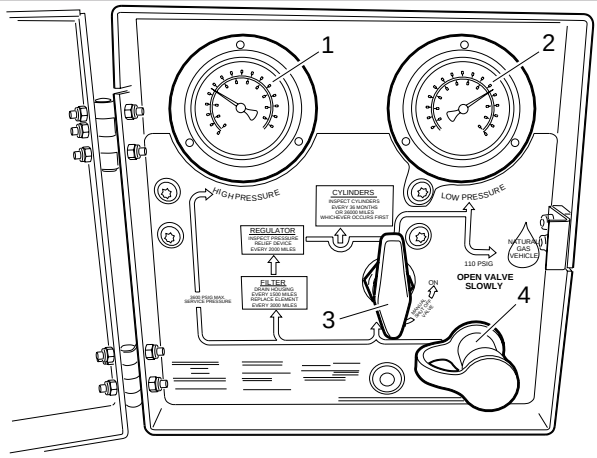
Fig. 7, Fuel Cylinder Storage Box Mounting Bracket (passenger side shown)

NOTE: During initial pre-delivery inspection (PDI), tighten the storage box mounting bolts (shown in **Fig. 7**) 180 lbf·ft (244 N·m).

4. Inspect the fuel fill port for signs of damage or leaks. Ensure the port dust cover and the O-ring inside the port are both present and in good condition. See **Fig. 8**.

5. Inspect the pressure gauges on the fuel box for cracks. Ensure the indicator needles are present and in working condition. Inspect the gauge faces for accuracy and legibility.

6. Ensure blue caps are present on all pressure relief devices. Each fuel cylinder is equipped with two caps (one on each end), which are visible on the back of the CNG fuel cylinder storage box. One cap is located on the pressure relief valve on the inboard side of the CNG fuel box, next to



1. High Pressure Gauge
2. Low Pressure Gauge
3. Manual Fuel Shutoff Valve
4. Fuel Fill Port and Dust Cap

Fig. 8, CNG Fuel Panel

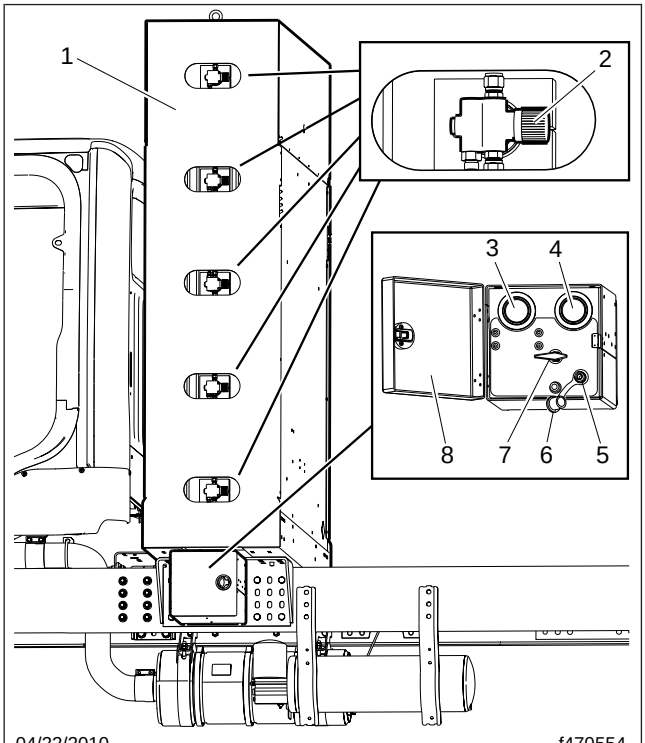
the fuel outlet line. Check the primary relief valve on the inboard side of the CNG fuel box for signs of damage or leaks.

7. Check the following components for signs of damage or leaks.
   - Manual fuel shutoff valve
   - Fuel cylinder shutoff valves (see **Fig. 9**)
   - Coolant hoses and fittings
   - Fuel lines and fittings
   - All fittings, connections, and joints
8. Replace leaking or damaged fuel lines. Repair or replace leaking or damaged fittings.

47–06 CNG High-Pressure Fuel Filter Element Replacing

CNG filter element replacement cycles are an important factor in maintaining the CNG fuel system integrity and ensuring maximum operating performance. Actual frequency of the filter element replacement could increase or decrease depending on the cleanliness of the fill station fueling system.

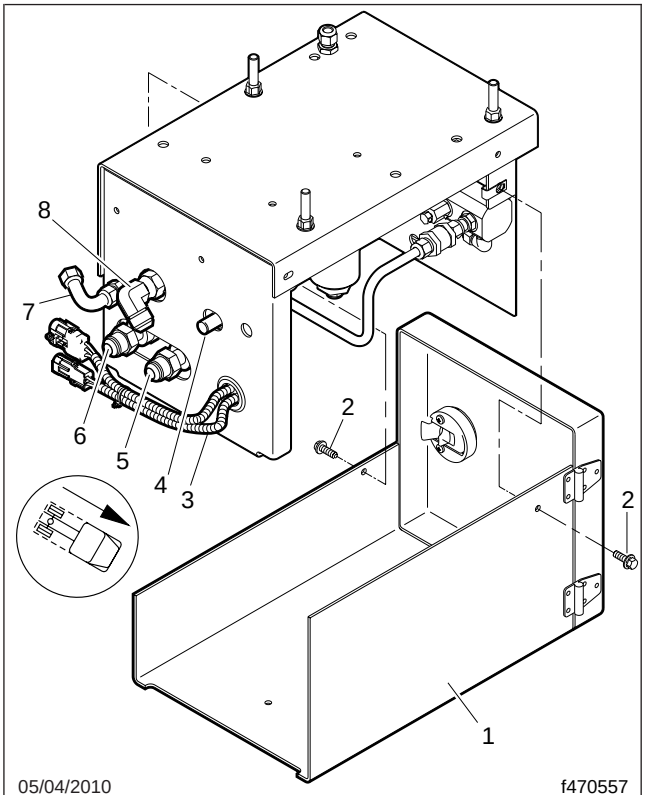
1. Shut down the engine and apply the parking brake.



1. Fuel Cylinder Storage Box
2. Fuel Cylinder Shutoff Valves (qty 5)
3. High-Pressure Gauge
4. Low-Pressure Gauge
5. Fuel Fill Port
6. Dust Cap
7. Manual Shutoff Valve
8. Fuel Panel Access Door

Fig. 9, CNG Fuel Cylinder Storage Box (5-cylinder system shown)

2. Close the CNG fuel cylinder shutoff valves.
3. Start the engine and let it idle until the fuel lines are empty and the engine stops. The gauges on the fuel panel should now read at or near 0 psi.
4. Close the manual fuel shutoff valve on the fuel panel.
5. Remove the two capscrews that secure the access cover to the fill panel, then remove the access cover. See **Fig. 10**. Save the capscrews for reinstallation.
6. Slowly open the bleed valve on the manifold to relieve remaining fuel pressure within the system. See **Fig. 11**.

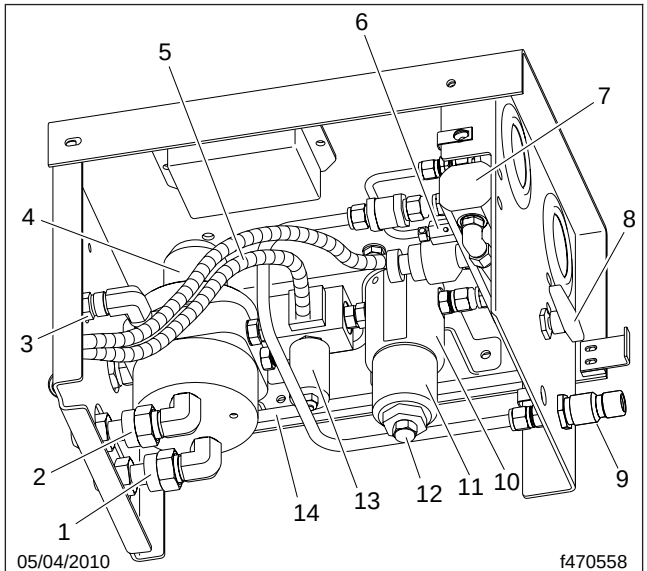


1. Fuel Panel Access Cover
2. Capscrews (qty 2)
3. Wiring Harness
4. Pressure Relief Valve and Cap
5. Coolant Outlet Line
6. Coolant Inlet Line
7. Fuel Inlet Line (to fuel cylinders)
8. Fuel Outlet Line (to engine)

Fig. 10, CNG Fuel Panel Assembly

IMPORTANT: Some pressure may remain in the fuel system between the solenoid valve and the engine. Use caution when loosening fittings, as a small amount of gas may leak out.

7. Put a clean receptacle under the filter assembly. Using a 1-1/4-inch wrench, unscrew the filter bowl from the filter housing.
8. Remove and discard the filter element.
9. Install a new filter element in the filter housing.
10. Inspect the O-ring on the filter housing for damage or cracks. If necessary, replace the O-ring.
11. Install the filter bowl on the filter housing. Tighten 90 lbf·ft (122 N·m).



1. Coolant Inlet Port
2. Coolant Outlet Port
3. Pressure Relief Valve
4. Pressure Regulator
5. Wiring Harness
6. Manifold Bleed Valve
7. Manifold
8. Manual Fuel Shutoff Valve
9. Fuel Fill Port
10. Filter Housing
11. Filter Bowl
12. Filter Drain Plug
13. Solenoid Valve
14. Fuel Line To Cylinders

Fig. 11, CNG Fuel Panel Components

12. Close the bleed valve on the manifold and open the manual fuel shutoff valve on the fuel panel.
13. Open the fuel cylinder shutoff valves.
14. Using a methane detector, leak test all fuel system components between the fuel cylinders and the solenoid valve. A bubble solution can be used to pinpoint the exact location of leaks.

    Repair or replace any leaking components.
15. Using the two capscrews removed previously, install the access cover on the fill panel.

47–07 CNG Fuel Cylinder Inspecting

Have a qualified inspector inspect compressed natural gas (CNG) fuel cylinders for damage or deterioration. Note cuts, cracks, gouges, abrasions, discoloration, broken fibers, loose brackets, damaged gaskets or isolators, heat damage, or other problems.

Refer to Compressed Gas Assocation (CGA) pamphlet C-6.4, *Methods for External Visual Inspection of Natural Gas Fuel Containers and Their Installations,* for inspection requirements and inspector qualifications.

For more information, go to **www.cganet.com**.

After inspection, an accurate and reliable written report should be provided for each container inspected. Place an inspection label stating the inspection date and inspecting agency identification on each container.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
CAT CGI Bellows Replacement	49–03
CAT CGI Bellows and Piping Inspection	49–02
Exhaust System Inspecting (Noise Emission Control)	49–01

49–01 Exhaust System Inspecting (Noise Emission Control)

In addition to inspecting the exhaust system at the scheduled maintenance interval, inspect the exhaust system if the noise level of the vehicle has increased. Freightliner Trucks recommends replacing parts that show leakage, wear, or damage, with genuine Freightliner parts.

The exhaust system must be free of leaks, binding, grounding, and excessive vibrations. These conditions are usually caused by loose, broken, or misaligned clamps, brackets, or pipes. If any of these conditions exist, check the exhaust system components and alignment. Align or replace as necessary; see **Group 49** of the *Business Class® M2 Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

It is a violation of US federal law to alter exhaust plumbing or aftertreatment in any way that would bring the engine out of compliance with certification requirements. (Ref: 42 U.S.C. S7522(a) (3).) It is the owner's responsibility to maintain the vehicle so that it conforms to EPA regulations.

EPA10 Exhaust System

Definitions of Aftertreatment (ATS) Terms

Refer to the following list of definitions of ATS terms and components.

- Aftertreatment System (ATS)—the entire exhaust system from the turbocharger to the exhaust stack or tail pipe.
- Aftertreatment Device (ATD)—a housing that contains the DOC and DPF (also the SCR and the mixing tube in one-box systems).
- BlueTec®—Daimler's proprietary SCR technology.
- Diesel Oxidation Catalyst (DOC)—a flow-through device that oxidizes soot in the ATD.
- Diesel Particulate Filter (DPF)—a component in the ATD that traps soot from the exhaust gas.
- Diesel Exhaust Fluid (DEF)—the chemical agent that reacts with the exhaust gases in the SCR to reduce NOx.
- DEF Pump—filters and supplies DEF to the DEF metering unit.
- DEF Tank—holds DEF and regulates its temperature.
- DEF Metering Unit—mixes DEF with compressed air, and meters this mixture into the exhaust flow via an injection nozzle.
- SCR Catalyst—the housing containing a treated ceramic flow-through block where the DEF and exhaust gases undergo selective catalytic reduction (SCR).
- Selective Catalytic Reduction (SCR)—a process used to reduce NOx emissions.

Inspection

To meet EPA10 emissions regulations for vehicles domiciled in the USA or Canada, engines manufactured after December 31, 2009 are equipped with an emission aftertreatment system. Vehicles domiciled outside of the USA and Canada may not have aftertreatment equipment, depending upon local statutory emissions guidelines.

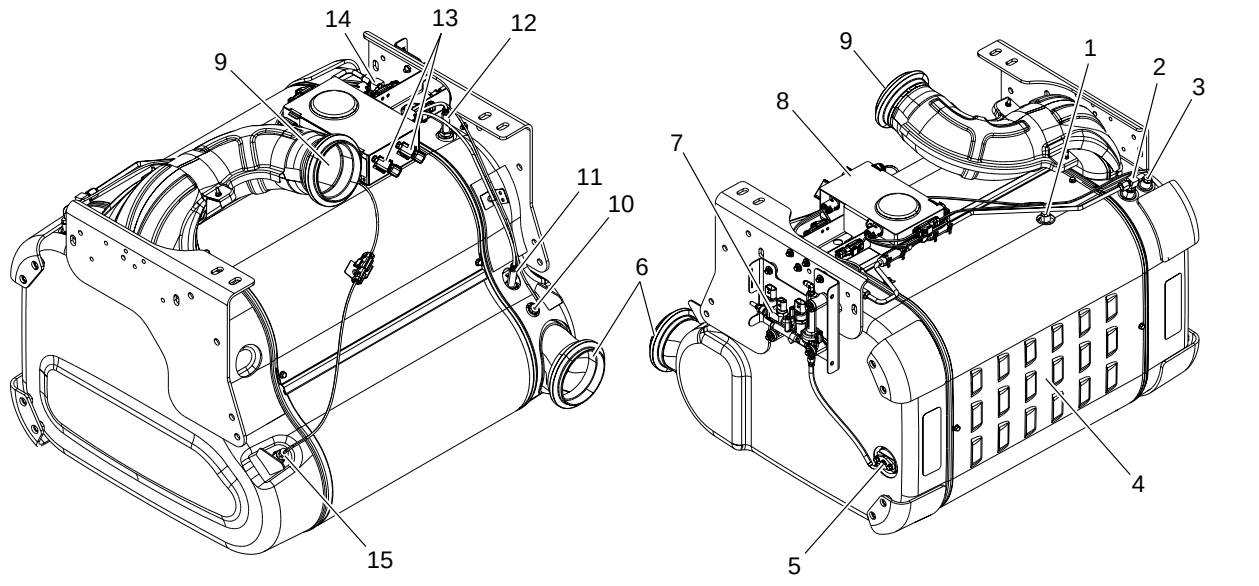
IMPORTANT: The aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections. No leaks are allowed anywhere in the system. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.
2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.

3. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD.
4. Check the ATD mounting bands for tightness. Tighten to 30 lbf·ft (41 N·m) if needed. Do not overtighten.
5. Check for leaks around the clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD.
6. Check all sensors attached to the ATS for leaks or damaged wires. No leaks are allowed. See **Fig. 1**, **Fig. 2**, or **Fig. 3** for Detroit Diesel ATS sensor locations.
7. Check the DPF exterior surface for dents or other damage. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
8. Check the SCR catalyst for dents and other damage.
9. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.

NOTE: Diesel exhaust fluid creeps, causing white crystals to form around the line fittings. The presence of crystals does not mean the system has a leak. Replacing fittings or trouble-shooting components is not necessary unless there is a system failure or a fault code.

10. Check the DEF tank, pump, metering unit, and lines for leaks. See **Section 49.03** of the *Business Class® M2 Workshop Manual* for repair procedures.



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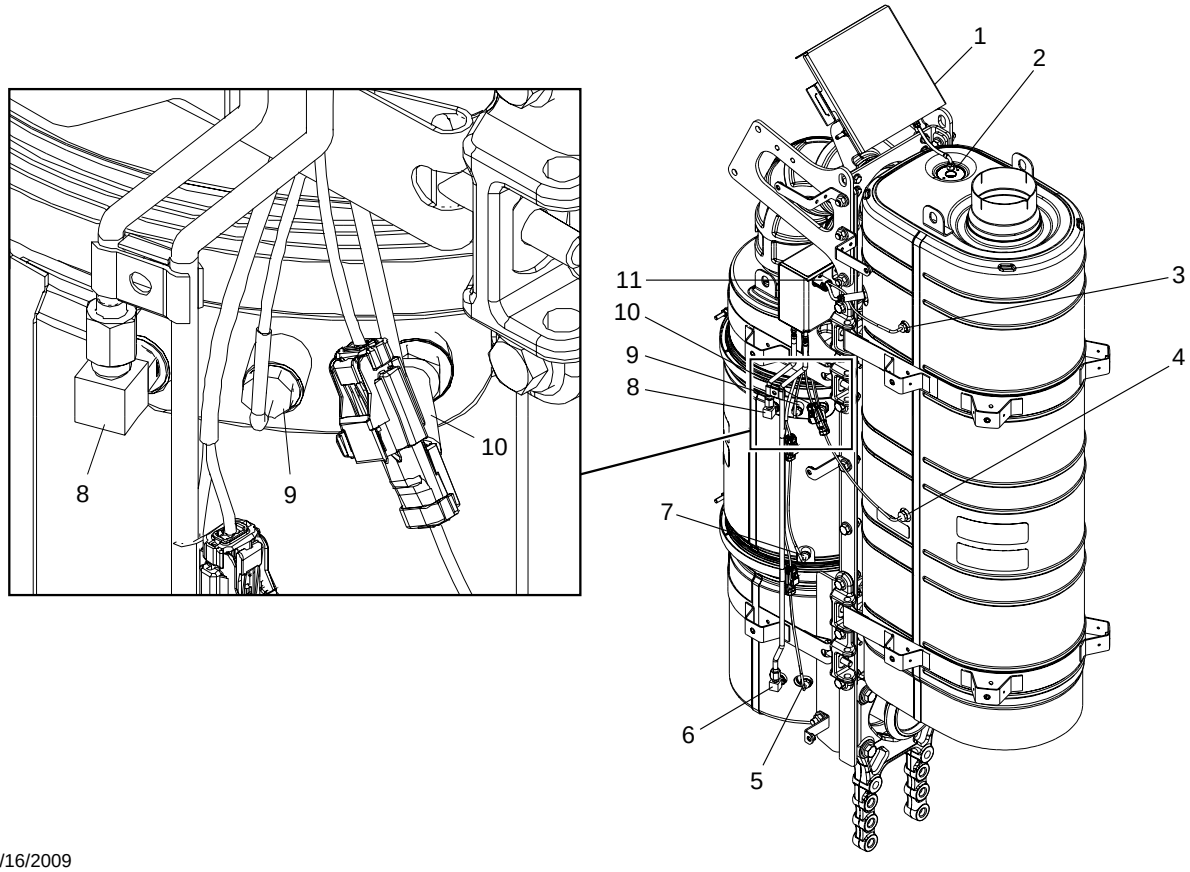
NOTE: The sensor box (item 8) contains the SCR inlet and outlet NOx sensors, DPF outlet pressure sensor, and the DOC inlet pressure sensor.

1. DOC Outlet Temperature Sensor
2. DOC Inlet Pressure Sensor Port
3. DOC Inlet Temperature Sensor
4. Front Heat Shield
5. DEF Nozzle
6. Exhaust Outlet
7. DEF Metering Unit
8. Sensor Box (see note above)
9. Exhaust Inlet
10. SCR Outlet Temperature Sensor
11. SCR Outlet NOx Sensor Port
12. SCR Inlet NOx Sensor Port
13. 14-Pin Connectors
14. DPF Outlet Pressure Sensor Port
15. SCR Inlet Temperature Sensor

Fig. 1, One-Box ATS Sensor Locations



1. DEF Metering Unit
2. DEF Nozzle
3. SCR Outlet Temperature Sensor
4. SCR Inlet Temperature Sensor
5. DOC Inlet Temperature Sensor
6. DOC Inlet Pressure Sensor
7. DPF Inlet Temperature Sensor
8. DPF Outlet Pressure Sensor
9. DPF Outlet Temperature Sensor
10. DPF Outlet NOx Sensor
11. SCR Outlet NOx Sensor

Fig. 2, 2V2 Two-Box ATS Sensor Locations

11. Check any wires, lines, or hoses within 4 inches (10 cm) of the exhaust system for heat damage. Repair or reroute as needed.

Diesel Exhaust Fluid (DEF) Filter Replacement

The Environmental Protection Agency's 2010 regulations require lower nitrogen oxide (NOx) exhaust emissions. Selective catalytic reduction (SCR) uses diesel exhaust fluid (DEF) to lower NOx emissions in the vehicle exhaust. A filter in the DEF pump prevents clogging of the DEF metering unit injection nozzle.

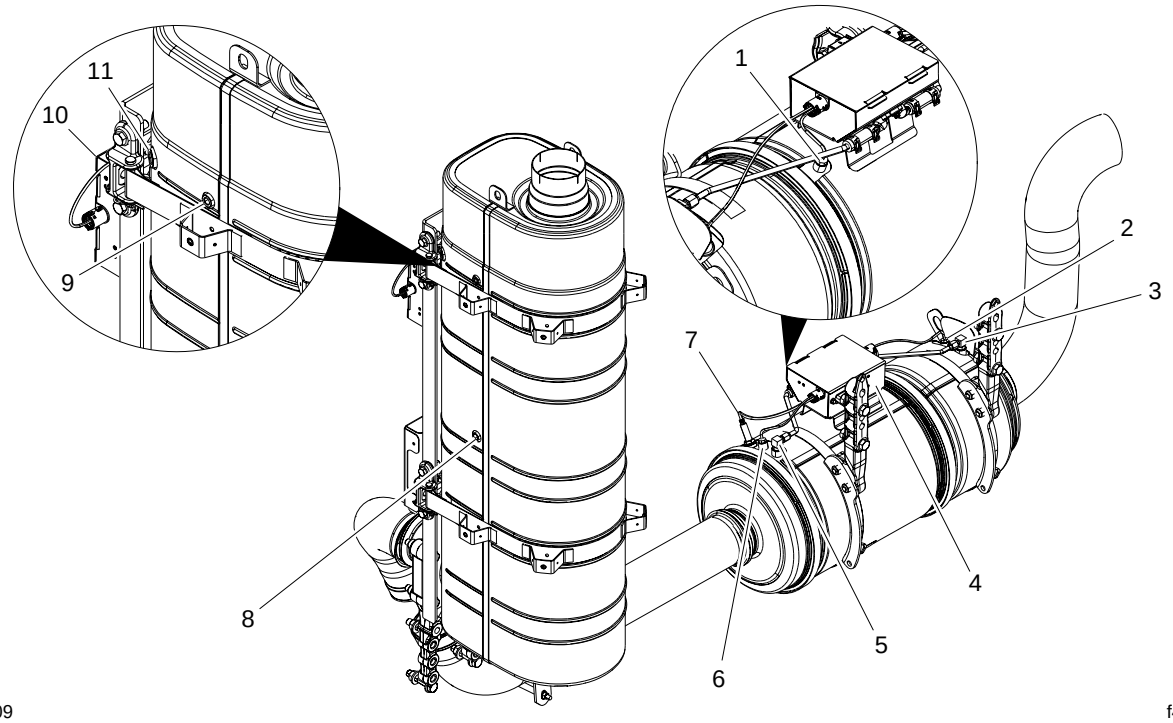
See the engine manufacturer's maintenance manual for filter replacement instructions and maintenance intervals.

EPA07 Exhaust System

Definitions of ATS Terms

Refer to the following list of definitions of ATS components.

- Aftertreatment System (ATS)—the entire exhaust system from the turbocharger to the exhaust stack or tail pipe.



1. DPF Inlet Temperature Sensor
2. DOC Inlet Temperature Sensor
3. DOC Inlet Pressure Sensor
4. DPF Sensor Box
5. DPF Outlet Pressure Sensor
6. DPF Outlet Temperature Sensor
7. DPF Outlet NOx Sensor
8. SCR Inlet Temperature Sensor
9. SCR Outlet Temperature Sensor
10. SCR Sensor Box
11. SCR Outlet NOx Sensor

Fig. 3, 2HV Two-Box ATS Sensor Locations

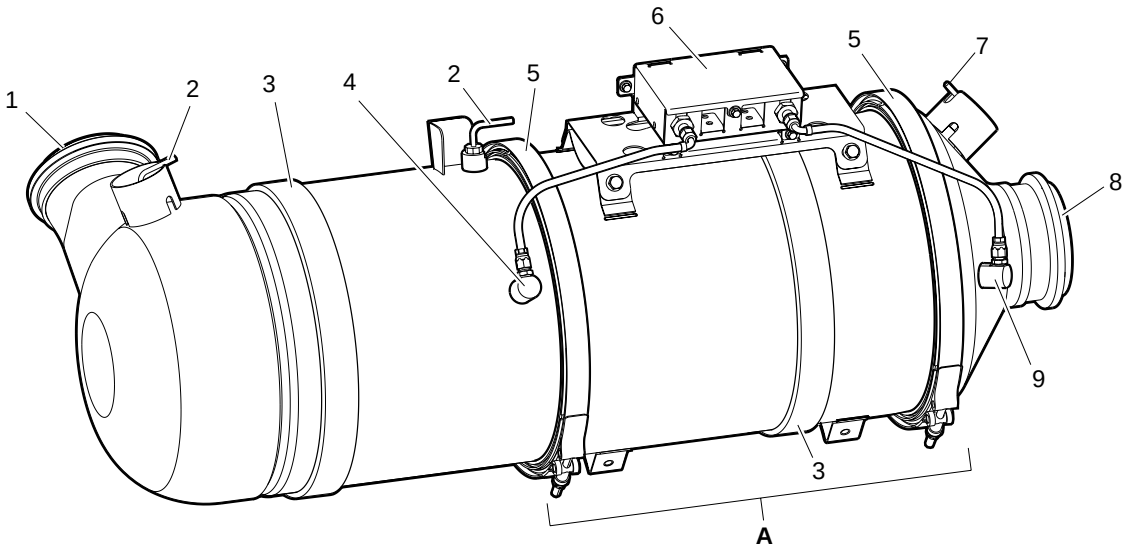
- Aftertreatment Device (ATD)—a muffler-like canister that houses a DPF, DOC, and sensors.
- Diesel Particulate Filter (DPF)—a filter that collects and holds particulate matter (soot and ash).
- Diesel Oxidation Catalyst (DOC)—oxidizes hydrocarbons and reduces NOx.
- Sensors—detect temperatures and pressures in the ATS.

Inspection

To meet EPA07 emissions regulations for vehicles domiciled in the USA or Canada, engines manufactured after December 31, 2006 are equipped with an emission aftertreatment system. Vehicles domiciled outside of the USA and Canada may not have aftertreatment equipment, depending upon local statutory emissions guidelines.

IMPORTANT: The aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections; see **Fig. 4**. No leaks are allowed anywhere in the system. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.
2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or



A. Inspect this area of the canister for dents.
1. Marmon Fitting at Inlet from Turbocharger
2. DOC Temperature Sensor
3. ATD Mounting Band
4. DPF Intake Pressure Sensor
5. DPF V-Band Mounting Clamps
6. Sensor Housing
7. DPF Outlet Temperature Sensor
8. Exhaust Outlet Marmon Fitting
9. DPF Outlet Pressure Sensor

Fig. 4, Typical Aftertreatment Device

damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.

3. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD.
4. Check the ATD mounting bands for tightness. Tighten to 30 lbf·ft (41 N·m) if needed. Do not overtighten.
5. Check for leaks around the clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD.
6. Check all sensors attached to the ATD for leaks or damaged wires. No leaks are allowed.
7. Check the DPF exterior surface for dents or other damage. See Item A of **Fig. 4**. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
8. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.
9. Check any wires, lines, or hoses within 4 inches (10 cm) of the exhaust system for heat damage. Repair or reroute as needed.

Pre-EPA07 Exhaust System Inspection

1. Inspect the exhaust manifold at the cylinder head and at the turbocharger for leaks. See the engine manufacturer's service literature for repair procedures.
2. Inspect the muffler body, muffler outlet stack, muffler shield, and inlet tubes for leakage, dents, corrosion, or holes in the muffler.
3. Inspect the exhaust pipe and each exhaust seal clamp for leakage, wear, or damage. Replace the exhaust pipe if needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal

clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.

4. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.

49–02 CAT CGI Bellows and Piping Inspection

On vehicles with CAT engines,

NOTICE

A leak in the CGI piping, including the bellows, will allow unfiltered air and contaminants into the engine intake, and can cause serious engine damage.

NOTE: Because the CGI bellows is covered with a metal mesh, it is difficult to see cracks or damage that may cause a leak.

1. Inspect the CGI bellows and piping for evidence of damage or leakage. See **Fig. 5**. If the bellows is damaged or leaking, replace it. See **49–03** for the replacement procedure.
2. Check the CGI piping and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced. If any of the components is damaged or leaking, replace it. See **49–03** for the replacement procedure.

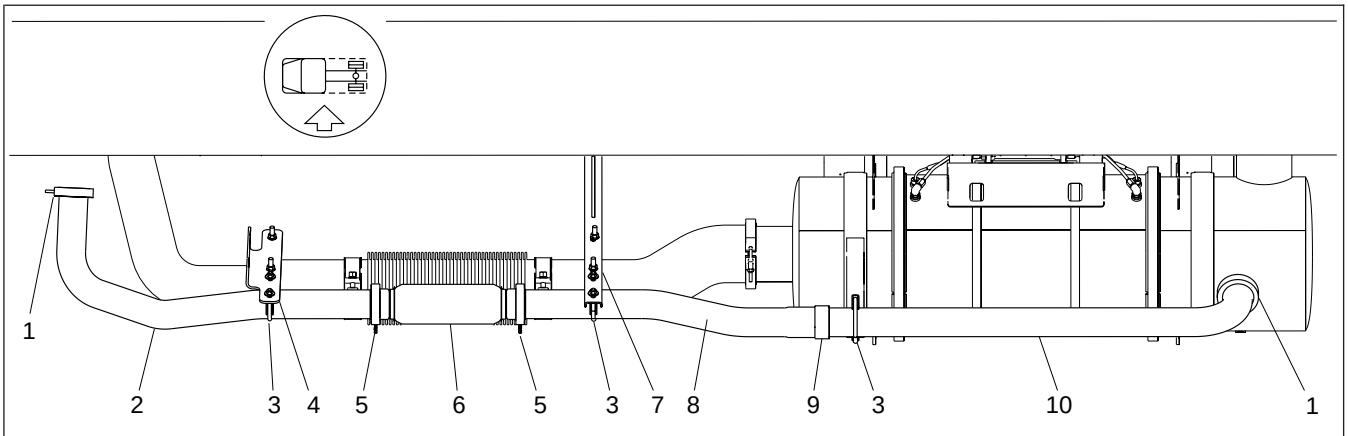
49–03 CAT CGI Bellows Replacement

On vehicles with CAT EPA07 compliant engines, replace the CGI bellows at the M3 maintenance interval to prevent a later failure.

NOTICE

A leak in the CGI piping, including the bellows, will allow unfiltered air and contaminants into the engine intake, and can cause serious engine damage.

1. Park the vehicle, set the parking brake, chock the wheels.
2. Open the hood.



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1. Clamp
2. Inlet Pipe
3. U-Clamp
4. Forward Pipe-Support Brace
5. Slip Clamp
6. CGI Bellows
7. Center Pipe-Support Brace
8. Center Pipe
9. Clamp
10. Outlet Pipe

Fig. 5, CAT EPA07 Exhaust Installation with CGI Bellows

3. Remove the right side inner fender/splash shield as needed.
4. Remove the CGI piping between the engine and aftertreatment device (ATD).

   See **Fig. 6**.
5. On the workbench, remove the CGI bellows from the exhaust piping. Do not damage the piping.

NOTE: The following step, and its substeps, is to be done without the bellows installed. This will align the pipes so that the bellows can be installed correctly.

6. Install the CGI piping (without CGI bellows) and align piping.
   - 6.1 Attach the aft CGI pipe to the ATD.
   - 6.2 Attach the forward CGI pipe to the engine.

NOTICE

When the CGI pipes and bellows are installed, there should be approximately 3/4 inch (19 mm) clearance from the main bellows. Contact between the bellows could result in an exhaust leak, which in this case may allow ingestion of contaminants into the engine causing engine damage.

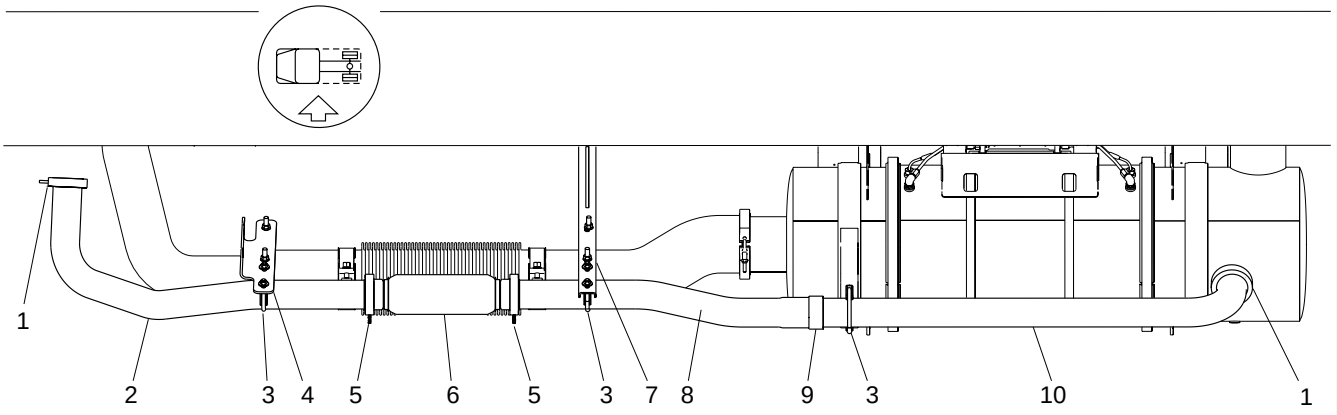
   - 6.3 Use a straightedge to align the pipes so that the pipe ends that attach to the bellows are parallel and concentric.

NOTICE

When shortening the CGI pipe(s), it is critical to leave a minimum of 1 inch (25.4 mm) of straight pipe on the end of each CGI pipe to allow for pipe insertion and clamp clearance. Failure to do this could result in an exhaust leak, which in this case may allow ingestion of contaminants into the engine causing engine damage.

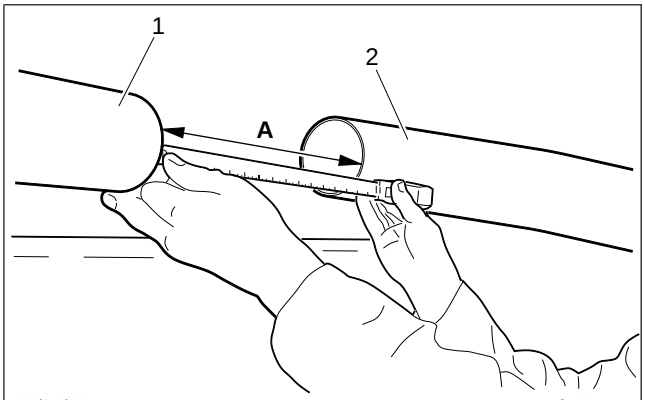
7. Once the pipes are aligned, measure the pipe gap between the CGI pipes and record the distance. See **Fig. 7**, Ref. A.

   The existing pipe gap is designed at 10 inches (254 mm). A 10.75 inches (273 mm) pipe gap is required for the replacement CGI bellows and clamps. This requires one or both of the CGI pipes to be shortened.
8. Using a yellow paint pen, mark the pipes 1.5 inches (38 mm) in from the end of each pipe. These two marks will be used to center the bellows between the two pipes.
9. Once the pipes are correctly aligned and separated at the correct distance, secure the aft CGI pipe to the ATD and to any CGI pipe support brackets.
10. Remove the forward CGI pipe from the truck.
11. Slide the slip clamp, with the retaining ring and graphite gasket ring, on the aft CGI pipe. See **Fig. 8** for proper installation.
12. Slide the new bellows onto the aft CGI pipe as far as it will go. See **Fig. 9**, Ref. A. Measurement A should be at least 7/16 inch (10 mm) past the face of the flange.
13. Install the slip clamp with the retaining ring and graphite gasket ring onto the forward CGI pipe. See **Fig. 10** for proper installation.
14. Slide the end of the forward CGI pipe into the bellows, and properly align the pipe.
15. Secure the forward CGI pipe to the engine and any CGI pipe support brackets.
16. Using the yellow marks, center the bellows between the exhaust pipes. Verify that the pipe is inserted at least 7/16 inch (10 mm) past the face of the flange. See **Fig. 9**, Ref. A.
17. Install the slip clamps on the bellows. Tighten the slip clamps 11 lbf·ft (15 N·m).
18. Start the engine and check for exhaust leaks. Tighten any clamps as needed.



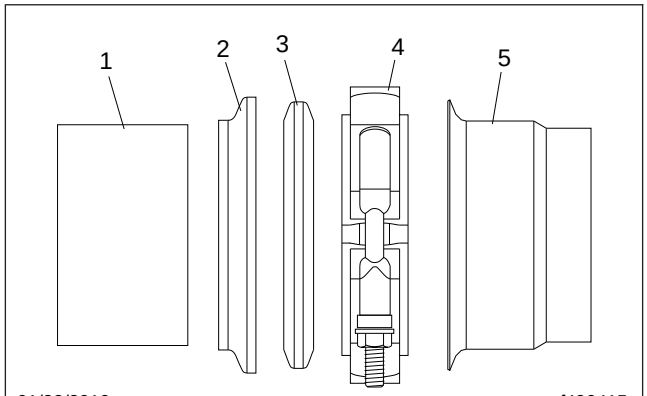
1. Clamp
2. Inlet Pipe
3. U-Clamp
4. Forward Pipe-Support Brace
5. Slip Clamp
6. CGI Bellows
7. Center Pipe-Support Brace
8. Center Pipe
9. Clamp
10. Outlet Pipe

Fig. 6, CAT EPA07 Exhaust Installation with CGI Bellows



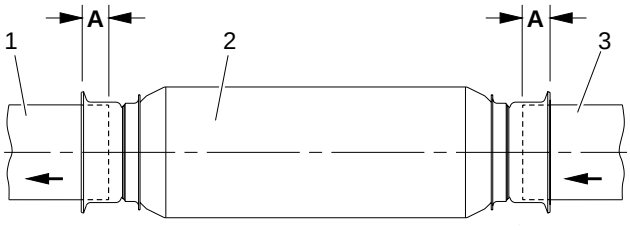
A. Measure the pipe gap.
1. CGI Aft Pipe
2. CGI Forward Pipe

Fig. 7, Measuring the Pipe Gap (typical)



1. Aft CGI Pipe
2. Retaining Ring
3. Graphite Gasket
4. Slip Clamp
5. CGI Bellows

Fig. 8, Aft Facing Slip Clamp Installation



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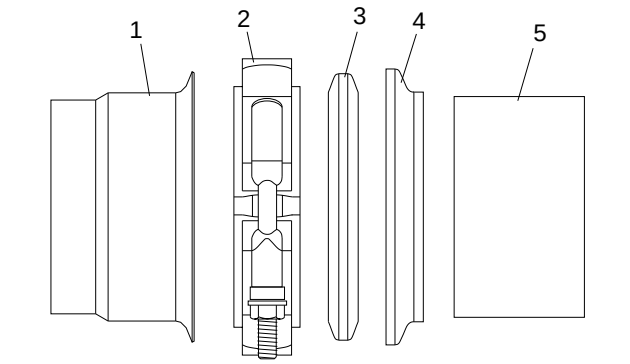
A. At least 7/16 inch (10 mm)
1. Forward CGI Pipe
2. CGI Bellows
3. Aft CGI Pipe

Fig. 9, CGI Bellows Installation



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1. CGI Bellows
2. Slip Clamp
3. Retaining Ring
4. Graphite Gasket
5. Forward CGI Pipe

Fig. 10, Forward Facing Slip Clamp Installation

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Title of Maintenance Operation (MOP)	MOP Number
Mirror Folding Check	60–01

60–01 Mirror Folding Check

For vehicles with folding main mirrors, make sure that the mirrors fold freely on the pivot points. Pivot each mirror fully forward and backward two times to break loose any debris that may affect the fold-away feature of the mirror.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Door Seals Lubricating	72–01

72–01 Door Seals Lubricating

NOTE: Only the door seals require lubrication. Do *not* lubricate the door latches or hinges. They come from the manufacturer with lifetime lubrication and require no maintenance.

Lightly coat the door seals with a lubricant that is safe for rubber.

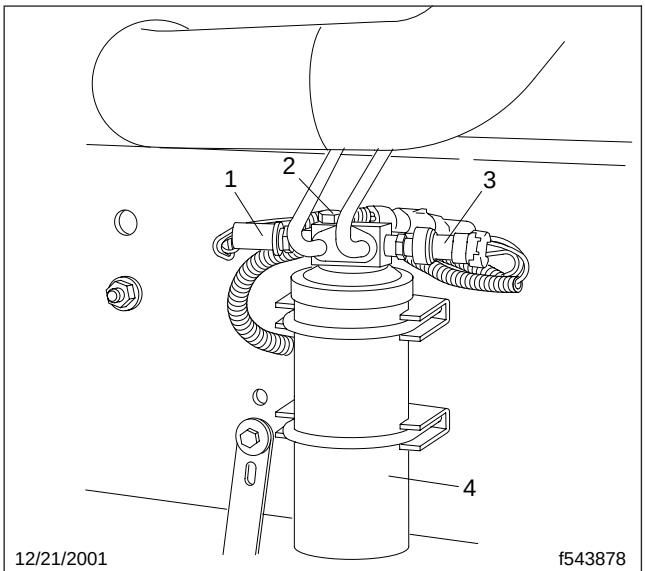
Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Air Conditioner Inspecting	83–01
HVAC Air Filter Replacing	83–02

83–01 Air Conditioner Inspecting

Refrigerant Compressor Inspection

1. With the vehicle parked on a level surface, apply the parking brakes and chock the tires.
2. Operate the heater and, if equipped with an air conditioner, the air conditioner to check for proper operation in all modes.
3. Open the hood.
4. Check the condition of the refrigerant compressor clutch assembly. If the friction surface of the pulley shows signs of excessive grooving due to belt slippage, replace both the pulley and the drive plate.
5. Inspect the refrigerant compressor drive belt for damage. If needed, replace the drive belt.
6. Check the tightness of the compressor mounting fasteners. The torque value for the mounting fasteners is 15 to 19 lbf·ft (20 to 26 N·m).
7. Inspect the drive plate. If the friction surface of the drive plate shows visible signs of damage due to excessive heat, make sure the refrigerant compressor turns freely. If the compressor does turn freely, replace the drive plate and clutch assembly. For instructions, see **Section 83.01**, Subject 140 of the *Business Class® M2 Workshop Manual*. If the compressor does not turn freely, replace the compressor. For instructions, see **Section 83.01**, Subject 120 of the *Business Class® M2 Workshop Manual*
8. Use a feeler gauge to check that the drive plate clutch clearance is 0.016 to 0.031 inch (0.4 to 0.8 mm). If the gap is not even around the clutch, gently tap down at the high areas. If the overall gap is out of spec, remove the drive plate assembly and change the shims as necessary. For instructions, see **Section 83.01**, Subject 140 of the *Business Class® M2 Workshop Manual*.
9. Check that the wiring harness connector is not damaged or loose. Replace the wiring harness if it is damaged.
10. Check the overall condition of the air conditioning hoses. Look for cracks, cuts, and abrasions on the hoses. Replace damaged hoses.
11. Check for a buildup of road debris on the condenser fins. Using air pressure and a whisk broom or a soapy spray of water, carefully clean off the condenser. Be careful not to bend the fins.
12. Check the moisture indicator on the receiver-drier. See **Fig. 1**. If the indicator is a deep cobalt blue, the refrigerant charge is dry. If the indicator is not blue, the system is contaminated with water. If the system is contaminated, recover the refrigerant, replace the receiver drier, evacuate the system, and add a full refrigerant charge. For instructions, see **Section 83.00**, Subject 220 of the *Business Class® M2 Workshop Manual*.
13. Close the hood and remove the chocks from the tires.



1. Fan Cycling Switch
2. Moisture Indicator
3. Binary Switch
4. Receiver-Drier

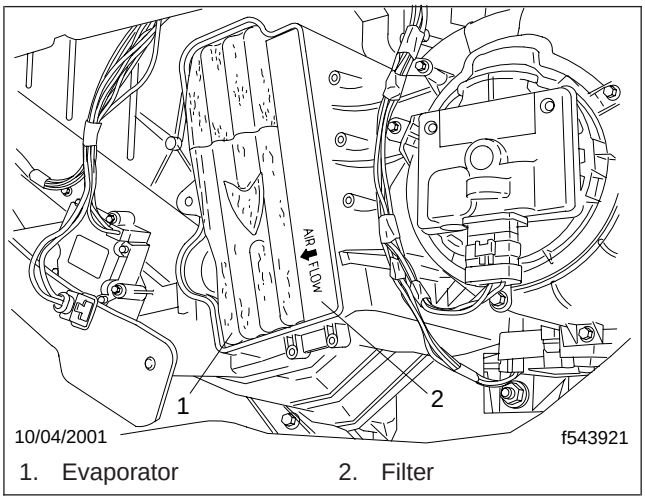
Fig. 1, Receiver-Drier

83–02 HVAC Air Filter Replacing

The HVAC air filter must be replaced every six months or 60,000 miles (97 000 km) to permit proper operation of the HVAC system.

1. With the vehicle parked, apply the parking brakes, and chock the tires.

2. Remove the lower HVAC cover in the cab. For instructions, see **Group 60** of the *Business Class® M2 Workshop Manual*.
3. Disconnect the wiring harness from the evaporator probe.
4. Remove the capscrews that attach the evaporator service cover to the HVAC assembly. Remove the evaporator service cover.
5. Pull the filter out of the HVAC assembly.
6. Install a new filter in the HVAC assembly. Be sure that the arrow on the filter is pointing toward the evaporator. See **Fig. 2**.



1. Evaporator 2. Filter

Fig. 2, HVAC Assembly Filter

7. Remove the condensate seal from the evaporator service cover and install a new condensate seal on the cover.
8. Using capscrews, attach the evaporator service cover to the HVAC assembly.
9. Connect the wiring harness to the evaporator probe.
10. Attach the lower HVAC cover to the dash panel. For instructions, see **Group 60** of the *Business Class® M2 Workshop Manual*.
11. Remove the chocks from the tires.

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Title of Maintenance Operation (MOP)	MOP Number
Hood Rear Support Lubrication	88–01

88–01 Hood Rear Support Lubrication

1. Apply the parking brakes and chock the tires.
2. Open the hood.
3. Clean both the hood- and cab-mounted hood rear support components with a soapy water solution.
4. Cover all contact surfaces of the hood rear support brackets and isolators with an approved multi-purpose, lithium-complex, soap-based grease; see **Table 1**.
5. Close the hood.

Approved Suppliers of Multi-Purpose Lithium Grease	
Supplier	**Grease**
Chevron	Delo Heavy Duty EP
Exxon	Unirex EP2
Mobil	Mobil Grease XHP 222
Shell	Retinax LC Grease
Texaco	Starplex 2

Table 1, Approved Suppliers of Multi-Purpose Lithium Grease